AGRICULTURAL ENGINEERING

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E. A. WHITE, President — FRANK P. HANSON, Secretary-Treasurer

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The Fourteenth Annual Meeting

THE annual meeting of the American Society of Agricultural Engineers which was held December 28, 29, and 30, at the Hotel Sherman, Chicago, had as its outstanding feature a larger measure of usefulness on the part of the society to agriculture, to related industries, and to educational work in agricultural engineering. This was true not only of the progress during the year just closed but also in the work under way for the future.

S. H. McCrory, of the division of agricultural engineering, U.S. Department of Agriculture, in the course of a report brought out the need for better means of contact between the work he represents and the departments of agricultural engineering in the various state agricultural colleges with whom and among whom it is obviously desirable to maintain correlation of effort, particularly in research work. Steps were taken toward the formation of a special section of the Society consisting of its members directly representing the institutions mentioned to act as a clearing house and coordinating agency. While many of the state college departments as well as the division of agricultural engineering of the U. S. D. A. are well represented in the society, provision is made for the admission without restriction of representatives from all state college departments and experiment stations to this section. It is understood that this section will be practically independent of the society as a whole and that its functions will be advisory only, its purpose being only to facilitate and make more efficient the combined work of the public agencies already existing. A committee has been appointed to take this up with the officials of the U.S. Department of Agriculture with a view to making this section of the greatest helpfulness, and at the same time consistent with the regulations and practice of the various public agencies involved.

SOCIETY COOPERATES WITH N. I. V. A

Another important work which has been set on foot is active cooperation with the tractor and thresher department of the National Implement and Vehicle Association in working out a fundamental study of power-farming methods with a view to determining authoritatively their inherent efficiency. This is largely an engineering research problem, and a difficult one because of the many complicating factors, each of which must be given proper value, and the disturbing circumstances for which allowance must be made.

Much interest attached to the report of the Standards Committee, presented by Raymond Olney, chairman, as it is through this committee that the Society carries on its standardization work in connection with the National Implement and Vehicle Association and the American Agricultural Equipment Standards Committee. In addition to a report of work already accomplished and that in progress the report contained recommendations for a better and more comprehensive organization of the committee together with suggestions for minor changes in the constitution of the Society to permit better articulation of its work with that of its collaborators in the standardization work.

The Society dinner the evening of the 29th had as its feature talks by C. E. Gunnels, treasurer, and J. R. Howard, president of the American Farm Bureau Federation. Mr. Gunnels spoke briefly on the organization, scope, and purposes of the Federation, emphasizing its representative character and the fact that it is proceeding along sound economic lines and avoiding political activity or bias. Mr. Howard, after calling attention to the fact that every item of farm operation or farm improvement involved agricultural engineering in its execution, proceeded to set forth the present economic and financial situation in its relation to the farmers of the country and showed how this situation would affect the agricultural engineers, particularly in their commercial connections. He made it very plain that the purchasing power of the farmer's dollar must be materially increased before there can be any great measure of prosperity in the various industries which directly or indirectly are dependent on agriculture in any form whatever.

PSYCHOLOGICAL TESTS DISTINCTLY HELPFUL

"Psychological Tests for Technical Efficiency in Agricultural Engineering" was the subject under which F.W. Ives of the agricultural engineering department, Ohio State University, presented the results thus far secured by Dr. H. E. Burtt, professor of psychology at the same institution, in the devising and application of psychological tests to determine the probabilities of success of students preparing for agricultural engineering as a profession. It may be stated that the results thus far secured, even though the tests are far from being perfected, are not always conclusive but in most cases are distinctly helpful.

E. V. Collins, assistant chief agricultural engineer of the Iowa agricultural experiment station, reported further progress in testing the draft of plows. One interesting development which may be mentioned is the fact that the increase in draft with speed, reported a year ago, applies to all standard types of plows, and that moldboards with a gentle turn, such as breaker bottoms do not ordinarily have the comparatively light draft with which they are credited. To facilitate these studies the power required to haul the plow with the bottoms out of the ground was determined and considered as an element of the power required when in normal operation. To separate the power consumed in cutting the furrow slice from that required to turn and pulverize it, use was made of a slice cutter which performed the former operation leaving the slice

practically undisturbed, after which the plow being tested was used to turn the cut slice. The power required for cutting was considered as the difference between that expended on cut and uncut slices. Although obviously open to certain errors the experiment pointed to the conclusion that increase of draft due to speed takes place in the turning and pulverizing portion of the plow's work.

Prof. O. W. Sjogren, head of the agricultural engineering department, University of Nebraska, reviewed the results of the tractor tests which have been conducted thus far in conformity with the famous Nebraska tractor testing law. It was pointed out that the tests were not calculated to discriminate against any particular make or type of machine but rather to exclude from sale within the state, tractors sold under misrepresentation, particularly as regards their ability to deliver their rated power under working conditions. In order to pass the test a considerable proportion of the machines were subjected to certain changes by the manufacturer, in some cases the rating being reduced, in others speed ratings were altered and in still others there were changes in equipment, particularly carburetors and manifolds. His paper also embodied interesting data compiled with reference to displacement per minute per horsepower for engines of different types and also for cylinders of different bore.

E. E. PARSONAGE TALKS ON WAGON STANDARDS

Under the title "Wagon Standards" E. E. Parsonage, of the John Deere Wagon Works, Moline, Illinois, described the standards which have been adopted in wagon manufacture and the substantial advantages which have resulted. He pointed out that formerly there were 4,560 kinds of farm wagons and that standardization had reduced this to 224, and the limit has not yet been reached. Similarly there was a time when there were six different widths of track varying from 4½ feet to 5 feet 2 inches. This confusion has given place to standarization on 56 inches, the standard motor-car track.

E. C. Mandenburg, of the Barrett Company, Chicago, Illinois, in a paper entiled, "Preservative Treatment of Timbers in Farm Structures" introduced his remarks by a few figures calling attention to the rapidly dwindling supply of timber in the United States and the need for providing for future needs by reforestation and for reducing the consumption of timber to the greatest extent possible through increasing the life of wooden structures by preservative treatment of the wood entering into their construction. He showed the increasing scarcity and the prohibitive price of woods which are considered durable and developed the thought that the non-durable woods which are more abundant and which are much less costly may have as long or even longer life than the more durable woods if they are given suitable preservative treatment. In his paper and in the discussion which followed it was brought out that fence posts up to a short distance above the ground line and all timbers coming in contact with masonry of any kind, particularly concrete, should be given preservative treatment because of the rapid decay which otherwise takes place in these locations, and the extremely high cost of installing replacements as compared with the value of the timber itself. The method of preservation which he described is that in which the wood is impregnated to a greater or less depth with refined coal-tar creosote, and his paper was supplemented by moving pictures showing several approved methods of performing the work.

In discussing "The Artificial Heating of Animal Shelters" K. J. T. Ekblaw, engineering editor, "National Farm Power," Chicago, Illinois, pointed out that it was not for the engineer to determine whether such heating was desirable but that it was the business of animal husbandry. He explained, that some farmers considered such heating desirable for their dairy barns and hog houses. The paper laid down the conditions to be met, the rsults to be desired, and developed typical plans for each of the two classes of buildings applying the principles to be observed. An important conclusion is the fact that neither in first cost nor in operating cost is artifical heating such as described so expensive as might be thought, as the heating desired is much less than for human habitations and is needed only during rather short periods of extremely cold weather.

"Land Clearing With Dynamite" was presented by Arthur L. Kline, of the Hercules Powder Company, Wilmington, Delaware. In addition to a presentation of technical matters covered by his subject he developed the needs of the future, when increased population will require for food production the development and use of all available land. The discussion showed an unusual degree of interest in the subject.

In his report as chairman of the committee on farm structures, W. G. Kaiser, of the Portland Cement Association, outlined briefly the history of grain storage on American farms beginning with the isolated single corn crib and the haphazard small grain bins through their various developments to the modern farm elevator, a combined small-grain and ear-corn structure designed specifically for use in connection with power operated elevating and distributing equipment and also with the power operated drag of the corn sheller. The economic and other features of various types of buildings were discussed, both those employing permanent built-in elevators and those intended for use with portable elevators. Proper ventilation for corn cribs, exclusion of rats and reduction of fire hazards were given serious attention also.

SUBJECT OF FUTURE TRACTOR FUEL STUDIED

In giving the report of the tractor committee the chairman, A. H. Gilbert, of the Rock Island Plow Company, stated that considerable study had been given to future tractor fuel, with the conclusion that fuel alcohol can be produced on a basis which will prevent fuel famine or prohibitive cost. It appears that a bushel of corn will yield about two and one-half gallons of one hundred per cent alcohol and proportionately more of a less refined product. It is claimed that the feed left as a by-product will cover the cost of distilling and that the only real obstacle to economical production and distribution of alcohol fuel is the excessive amount of restriction and red tape imposed by the government. Mr. Gilbert predicted that the time would come when the corn fields of Illinois and Iowa would compete or cooperate with the oil fields of Oklahoma and Texas. The committee also is at work on tractor lug equipment, in regard to which Mr. Gilbert stated that while no results were ready for report at the present time the need for definite research data on the subject was great, particularly as there is probably no point in tractor design or operation concerning which less definite data has been gathered nor for which the fundamental principles are so poorly understood.

Other committee reports calling for special mention include that by R. W. Trullinger, specialist in rural engineering, States Relations Service, U. S. D. A. for the Research and Data Committee, being a discriminating review of real research in agricultural engineering at the various experiment stations and in fact throughout the world. Commenting on the comparatively small amount of work he could mention as true research he took occasion to distinguish research,

the discovery and development of new scientific knowledge of a fundamental nature, from the mere investigation of existing agencies and methods. He made a strong plea for more genuine research.

The report for the committee on barn ventilation was made by W. B. Clarkson of the King Ventilating Company, Owatonna, Minnesota. He reviewed the progress which the committee had made in zoning the United States with respect to climatic conditions as they affect the design of barns and most particularly the ventilating system, some of which work already has been reported in these pages. He also showed the need for better contact and cooperation among engineers interested in such separate but related fields as barn architecture, barn equipment, such as litter carriers, stall fixtures, etc., and those responsible for the design of ventilating systems and equipment.

For the committee on drainage reports were made by S. H. McCrory, Division of Agricultural Engineering, U. S. D. A., and David Weeks, Drainage Engineer, Dakota Engineering Company, Mitchell, South Dakota. The technical nature of these reports makes difficult any brief mention of the ground covered, but it may be said that they contained technical information of much practical value to the professional engineer engaged on drainage projects of considerable size.

In the presidential address which featured the opening session F. N. G. Kranich drew the attention of members to the greatly increased recognition and prestige which came to the society during the year 1920. Among the evidences of this he mentioned the number of times that members of the Society had been called on to address other organizations, the influence of the Society in its cooperative work with the U. S. Department of Agriculture and the National Implement and Vehicle Association, as well as in certain other connections, and the large increase in the membership, including many persons of prominence.

SECRETARY REPORTS ON 1920 MEMBERSHIP

In this connection the Secretary reported that during 1920 there had been elected 113 members, 57 associates, 12 juniors and 6 affiliates, a total of 188. During that time the Society has lost one member by death and four by resignation, leaving a net increase for the year of 183 members. The total membership now consists of 302 members, 154 associates, 33 juniors, 14 affiliates and 66 student branch members—a total of 569. There were at the time of the report 33 applications for membership pending. The student branches and their membership are: Iowa State College 14; Nebraska 9; Missouri 12; Ohio State University 22; Wisconsin 9; and there are 17 applications for this grade of membership from Kansas State Agricultural College.

At the last session of the meeting the following resolutions, drawn up by the resolutions committee, consisting of W. B. Clarkson, I. W. Dickerson, and K. J. T. Ekblaw, were unanimously adopted:

RESOLVED, That the American Society of Agricultural Engineers heartily endorses and supports any activity which has for its object the establishment of reasonable, logical and intelligent standards, based on research, investigation, experimentation and practice.

RESOLVED, The thanks of the society are extended to J. R. Howard, president, and C. E. Gunnels, treasurer, of the American Farm Bureau Federation, for the very excellent and inspiring addresses presented at the banquet, and assurance is given them of the support and cooperation of the Society.

RESOLVED, That the society extend its sincere thanks to the retiring officers, F. N. G. Kranich, president, and J. B. Davidson, secretary, for their earnest and conscientious efforts to promote the welfare of the Society.

RESOLVED, The appreciation of visiting members is hereby tendered to the local committee on arrangements for its excellent work in preparing for this meeting and particularly for the enjoyable banquet and program; and to the Portland Cement Association for their courtesy and cooperation in promoting the success of the meeting.

At the close of the meeting Mr. Kranich called to the assumption of his duties the president-elect, E. A. White, technical editor, "Farm Implement News," Chicago, Illinois. The other officers are: First Vice-president, W. G. Kaiser, Portland Cement Association, Chicago; Second Vice-president, E. R. Jones, University of Wisconsin; Secretary-Treasurer, Frank P. Hanson, Station A, Ames, Iowa. The Executive Council for 1921 consists of I. W. Dickerson, Charles City, Iowa, agricultural editor for a group of farm papers; F. N. G. Kranich, Hyatt Roller Bearing Company, Chicago, Illinois; Raymond Olney, The Power Farming Press, St. Joseph, Michigan; F. A. Wirt, Emerson-Brantingham Company, Harrisburg, Pennsylvania; J. B. Davidson, Iowa State College, Ames, Iowa. The retiring members of the Council, A. J. R. Curtis, Portland Cement Association, Chicago, Illinois, and Daniel Scoates, Texas A. & M. College, are succeeded by the outgoing president and secretary.

Possibilities of Alcohol for Fuel*

By A. H. Gilbert**

A SUBJECT requiring urgent attention, or with great possibilities if given proper support, is that of the fuel situation for internal-combustion engines. Reports from the American Petroleum Institute recently have shown very clearly how the consumption of fuel has been exceeding production. They are urging the conservation of gasoline as well as a more efficient use of the same. We find that only in 1913, 1914 and 1915 the production was far greater than consumption which resulted in a low price for the fuel. In fact, the price of crude petroleum per barrel reached a point where the larger companies, as well as the small, felt that they could not afford to drill more wells; so in 1916 the production decreased some forty million barrels. This meant that with the great increasing demands by use of the tractor, truck, and passenger cars, in addition to the tremendous drain during the war, the production has not been able to come up to the demand until the last couple of months.

My object in reviewing this brief history is to show how oil industries are regulating fuel prices. This is a product of which we cannot control the source of supply. We are merely drawing on Nature's great reservoir and while we daily read of predictions pro and con, no one knows definitely how long it will last. We do know that this present price of fuel and oil is seriously affecting power farming.

Considerable research work has been conducted comparing alcohol with gasoline as fuel for internal-combustion motors. Your chairman of this committee has made an effort to follow these reports and the interesting thing is that no one seems to throw cold water on the possibilities. It is further shown that it is possible to obtain approximately five gallons of alcohol, one hundred per cent proof from one bushel of corn; further, that the by-products of this material in the form of feed and corn oil will practically pay for distillation.

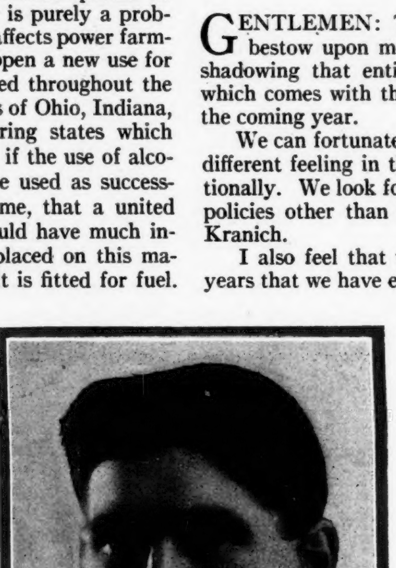
*From the report of the tractor division of the farm power, belt and field machinery committee. Presented at the Annual Meeting of The American Society of Agricultural Engineers, Chicago, December 27 to 30, 1920.

**Mem. A.S.A.E., tractor engineer, Rock Island Plow Company, Rock Island, Illinois.

The heat value of alcohol is considerably lower than that of gasoline, ranging around 1100 to 1200 against 1900 to 2000 B. t. u.'s, per pound for gasoline and kerosene. This difference in heat value is offset somewhat by the fact that alcohol is heavier than gasoline and that there are a larger number of pounds per gallon. In taking these matters into consideration the proposition seems very feasible and the most serious objection at the present time is that of the high revenue placed on alcohol. It appears to us that this matter is purely a problem for the agricultural engineers in that it affects power farming very seriously and since it would also open a new use for the great abundance of corn which is raised throughout the Middle West, in other words, the cornfields of Ohio, Indiana, Illinois, Nebraska, Kansas, and neighboring states which would be turned into oil lands and we feel if the use of alcohol for internal-combustion motors can be used as successfully as seems possible at the present time, that a united effort on the part of this organization would have much influence in at least reducing the revenue placed on this material when adulterated to a point where it is fitted for fuel.

Our New President

THE election of E. A. White as president of the American Society of Agricultural Engineers carries incidental interest to the older friends of the society because it has been pointed out that every charter member of the society now living has come to its presidency. Dr. White holds a doctor's degree in agricultural engineering from Cornell University. This is believed to be the first and only degree of its kind ever granted in America, and bears testimony to a high order of engineering skill and research ability.



DR. E. A. WHITE

Dr. White's research work at Cornell was devoted largely to the moldboard plow and resulted in the establishment of a working theory and a mathematical way of expressing in three algebraic terms the shape of any successful moldboard plow. It may be said that Dr. White probably has done more than any other man in American to bring plow design from an art to a science.

It may be remarked that Dr. White was born and raised on a farm in northern Illinois, that he is a graduate of the college of agriculture, University of Illinois, and that before and following his post-graduate work at Cornell was in charge of agricultural engineering work at the University of Illinois for seven years. In this capacity he started and carried on up to the time he left the university one of the most comprehensive studies ever attempted of the cost of tractor operation together with other important facts such as per cent of time lost in trouble, amount of use annually, etc.

Dr. White left the university to become research engineer for the Peoria plant of the Holt Manufacturing Company. He has for a number of years been an extensive and authoritative writer on farm machinery and power-farming equipment and methods, and is now technical editor of "Farm Implement News." He has assisted in the supervision of national tractor demonstrations and managed smaller demonstrations, particularly those of motor cultivators.

President White Blows Whistle for 1921 Kick-Off

Dr. White's remarks on his installation as president of the American Society of Agricultural Engineers for 1921

GENTLEMEN: The honor which you have seen fit to bestow upon me is very greatly appreciated, but overshadowing that entirely is a thought of the responsibility which comes with the office which I have the honor to hold the coming year.

We can fortunately go into this new year with an entirely different feeling in the Society than we are experiencing nationally. We look forward to and expect no radical change in policies other than those that have been initiated by Mr. Kranich.

I also feel that we are entering one of the most critical years that we have ever experienced because of the work that has been done this past year. Gentlemen, we have a standard to come up to. The work of this Society the past year has been remarkable. The work which the officers have done has been most commendable and if we let this slip back now we are in for another forty years in the wilderness. Therefore, I lay a charge upon every one of you to support this administration as becomes members of this Society.

If plans which I have in mind are adopted by the Council, we are going to spread out this responsibility. We are going to spread it wide and thick, just like the dairy people advertise their butter—spread it on thick. That is the way responsibility is going to go this year, it is going to be spread on thick.

I am going to take into my office something that I learned in coaching football, something that every successful football coach knows. It isn't a matter primarily, of retaining cordial relations between the coach and the team, if you want to put it that way, entirely; it may be necessary for me to get some of you fellows a little mad. I heard a successful coach say not long ago, that if he had not had a season as successful as he thought it should be he took the responsibility for it because he was too easy on his men.

We want the most cordial relations between you gentlemen, but when we designate certain work to a committeeman, I want to tell you that I have a good big basket in my office and any letters that come back saying "We are too busy," unless you are flat on your back, will go into that basket and I will write you another letter. I am not going to keep them in the files. I don't want them in the files of this Society. I believe that it is the work of the president of this Society to distribute work and see that it is done. If he does that he will be as busy as any man in the organization.

I have proceeded on that policy in formulating plans and I have found a wonderful response from the members, which leads me to believe that you are going to measure up fully to that standard; therefore, we shall proceed on that basis and I firmly believe that we shall succeed.

The President's Annual Address

By F. N. G. Kranich

MY ASSOCIATION with the members of our Society by virtue of the honor bestowed on me last year has brought me in closer contact with the various branches of agricultural engineering than has anything else I have ever had the opportunity of doing.

In this message I shall not review in detail the activities of this society during the past year. I shall, however, endeavor to bring you all to a realization of the valuable work our Society has started and can do.

Every member of this Society, particularly the older ones, knows what has been done. They know about our affiliations with the National Implement and Vehicle Association and the industry as a whole. You all know about our paid secretary. You all know about our journal and what it proposes to accomplish and what it stands for. You are all familiar with the activities that have been going on.

You have all been a part in this past year's developments, and what I of my own self have done or could do is negligible. Each and every one has contributed his share in bringing about the results of which you are all proud. If we have made progress it is because each member has put his shoulders to the wheel and has given a lift.

The splendid support and cooperation from among our members, particularly those on committees working together, has been one of the most gratifying factors of all. This fellowship has permeated the entire institution for good, not alone of the Society, but for the good of each individual.

I cannot help but feel that these associations of our members and friends in our committee meetings, and even at this time of the year in our annual meeting, makes for better men, better engineers, and for better final results. It is after all the associations we have that broaden us. I believe very earnestly and sincerely that every one of you attending this meeting at this time is getting much more good out of it because of these associations.

We get together during our leisure time here and talk shop. We talk the things that we live, those that are nearest to us. We discuss these things with each other and we cannot help but learn from this personal contact with each other. These associations make for enthusiasm which helps us in the work we are doing back home and in that art in which we are working. As Emerson said, "Nothing great was ever achieved without enthusiasm."

I honestly believe that this enthusiasm is due to a fuller appreciation and a greater recognition, not alone by you members but by everybody with whom we come in contact, of the value of agricultural engineering in our economic system.

I think the appreciation, or recognition of what agricultural engineering stands for, is one of the biggest things we have achieved.

Agricultural engineering serves an industry of far greater importance than does any other engineering fraternity. I say this with some thought, not that I discount the value of the work and efforts of others, but I more fully realize and appreciate the greater importance of ours.

It has been a decided privilege to work as I have during the past year with the membership of this Society and with those on the outside for the results we know are coming.

The things that we have accomplished in a tangible way are to me only secondary to that thing which I wish to call *recognition.*

Our Society during the past year has received that recognition which we have so long sought. We have received it in several ways: First, through our associations with the implement manufacturers, who are the builders of farm equipment; second, through the personnel of the men who have joined our Society this past year. I want you all to look over the list of members, as it stands today, and see if anywhere, or in any other institution there can be found such a list of representative men who so thoroughly cover every phase from the teaching clear through the practical side of agricultural engineering.

Our work in the Agricultural Equipment Standards Committee, the chairmanship of which your president has the honor of holding, is also a recognition that should be noted. That committee has many representatives who are members of our Society. Its work is progressing slowly, but after we get it started and in action, the results will be far reaching and for the good of the industry we represent and agriculture as a whole.

Recognition has also been given us in the press, and I am sure that it is the constructive work we are doing in an unmercenary way that affords us this recognition.

This recognition is also apparent when we think of the various meetings of big men in the industry with whom it has been our pleasure to work and have our members address. We have been associated with men representing the highest ideals and with associations representing the very best efforts for good in an industry that is fundamental, and that is, agriculture.

We cannot help but be proud of this recognition, and I am willing to say for my own self that this one thing is to me the most gratifying of all our efforts. It also means that we are coming into the light of things by the aid of this recognition, working toward an end which means advancement in the science and art of what I believe to be the most basic engineering effort in existence.

SOCIETY NEEDS FEEL NO FEAR OF ENCROACHMENT

We may at times be crossed by the activities of other bodies of men that may seem to conflict. We may find others encroaching or at least endeavoring to on what we feel to be purely agricultural engineering. We need have little fear as I see it of this because of the personnel of our organization. In no other engineering organization that I know is there such a body of men as we have—men who represent the industry as a whole, men who are in sympathy with agriculture and its development, and last, but not least, men who thoroughly understand the theory, the function, and field operation of farming equipment such as tractors, plows, threshers, and all the rest of the machinery so necessary to successful agriculture.

Our fourteen years of existence has given us a fund of knowledge that cannot be duplicated anywhere. Our data is all based on facts gathered by our members who have ap-

plied agricultural engineering to actual tests on farms and in farming operations.

We are represented in practically all the agricultural colleges in America. What greater influence could be found for the good of the industry. Members in the profession are spreading this gospel of agricultural engineering in their respective localities. Regardless of how high we stand, our state colleges stand at the top in this line and receive the recognition that is due them in this phase of engineering.

Even in the United States Department of Agriculture we now have within a bureau a division of agricultural engineering. The advisory committee of this division is composed of our members. Even at the head of the division is a very active member of our Society.

The work that this division of the federal government is planning is a correlation of the efforts of the colleges, together with that of our Society, which we know is going to help this big problem of agricultural engineering as a whole, and when I say "help" I refer not to any individual or not to any individual society, but for the good of that great body of men represented as the American farmer.

SOCIETY CAN HELP IN SOLVING TROUBLES

Our thorough understanding and sympathy with the problems of the farm equipment manufacturer fits us well to work with him. The personnel of our Society as individuals, as a part of these manufacturing institutions, as officers in these institutions, even as presidents of many of them, all working hand in hand toward a goal, which means results, is as gratifying to you all as it is to me.

The work of your standards committee, and in fact all the committees, relating to or cooperating with this parent standards committee, is bearing fruit. The things we are doing and the reports of the standards committee, which is being published in the last Journal, is to all of you a pretty good reason for our existence.

The need for this work in the industry we represent is recognized. The steps we have taken to bring about this recognition have been slow, but I feel very sure the plans for the future that we now have, and which our new president is endorsing, are going to bear fruit far in excess of our most humble expectations.

There is another thing I wish to bring out here and I believe should get more recognition, and that is that agricultural engineering is really an art and a science. It has been said very often that there is no such thing as engineering in agriculture. I take issue with all such claims.

I am very sure and I know you will all support me that the names of McCormick, Deering, Deere, Oliver, Dain, Dingee, and many others that I might mention, stand for as much, if not more, in the history of our nation as do the names of men that you may think of that have worked in other professions.

This to me is a fact that we should learn and we should talk about in spite of all that is said to the contrary for there is engineering in agriculture and much of it.

I feel very sure that these men have contributed to those things in our country's development which have made the others possible. By the efforts of these men in producing agricultural machinery, they have made it possible for so many of us to live in the city and so few of us on the farms. By their efforts they have made it possible for us to live as well as we do. It is this recognition of these men, who have actually worked at agricultural engineering, although in those days unrecognized and even today to some extent without recognition, that makes for this greater agriculture of which we are all so proud.

Our Society deals with the phase of engineering that is to the speaker far more important than any other branch of engineering that is today being practiced. It deals with those things that are absolutely basic and fundamental.

The engineering work in irrigation and drainage is of inestimable value. To make arid land produce food by the application of irrigation is wonderful. To drain wet lands and make them garden spots of food production is part of the work of the agricultural engineer.

Then there is the work of those men devoting their time to land clearing which is to give us millions upon millions of additional acres of fertile, tillable land upon which the farmer may produce food.

The work of those men who devote their time to farm structures, whether it is the home with its lighting and its modern sanitary equipment, or a barn with its modern equipment, or a silo, or a corn crib, or any farm building, should get the recognition of us all. It is these things that make for economic food production. It is these things that make farming more a pleasure than a task.

And who will dare say that these things are not agricultural engineering, or that they are even secondary to other engineering efforts? This is a part of the work in which our Society deals. It deals with agriculture which is the foundation of a nation.

Nations rise and fall in proportion as their agriculture increases and decreases. Agriculture increases and decreases and becomes a factor only as fast as the agricultural engineer is enabled to develop equipment for work on the farms. In other words, the history of every nation is nothing more or less than the history of its farm equipment, its agricultural engineering developments.

Far be it from me to make any suggestions that are radical departures from what we have been doing but a closer cooperation between the council members and the officers of the Society is desirable.

A closer relation between the activities of the committees with a common purpose in mind should be encouraged. A closer relation with the manufacturers in handling their technical matters should also receive much consideration. Another thing that deserves some consideration should be the reliability and accuracy of the things we publish under our name. It should be borne in mind that they are read by a large number of people, and it should also be remembered that as an influence for the future, these things should be very carefully selected and based on facts as we find them.

As I said before, this Society today contains the greatest fund of knowledge and the most authentic data on agricultural engineering that may be found anywhere. As time goes on, therefore, the more care that is exercised in bringing out future articles on this subject, the more we will be contributing in the way of facts to the literature on the subject.

I also believe that the activities of our educational committees should be enlarged. I believe under this heading we should embrace publicity. In other words, we should refrain from "hiding our light under a bushel."

We have no selfish motives. In fact, all our work is based on doing good for the industry, which after all means for agriculture, which is represented by the farmer.

It may be a little out of order, but I am going to take this opportunity to express my appreciation of the splendid work that has been done by your secretary, Prof. J.B. Davidson. I do this because his influence in this Society and in the industrial world stands out far above that of any other indivi-

dual that it has ever been my pleasure to know. His thorough understanding and keen sense of business judgment has been a factor, not alone in this past year's activities, but also in those long past dating from the origin of this Society.

I wish at this time also to express my sincere appreciation for the help that every member of the committees has afforded, that every member of the Society has contributed to the welfare of the Society, and to the Council which has laid down a path on which we shall proceed and which will lead to a greater recognition for doing the greatest good to an industry serving the most fundamental of all industries, that of agriculture.

Research In Agricultural Engineering*

By R. W. Trullinger**

THIS report summarizes the more important features of work in agricultural engineering research which has been completed or in progress during the past year, more especially at the state colleges and agricultural experiment stations and incidentally at some other public and private institutions in this country and abroad and formulates some general recommendations as to procedure in future research work.

A great deal of work related to agricultural engineering has been in progress, but a review of projects and of data already submitted indicates an apparent lack of the research spirit in a great number of cases. This is probably largely due to circumstances. A striking feature of the work is the fact that a large part of it has apparently been conducted either by or in cooperation with some other agricultural division to meet immediate needs in the solution of a specific problem. This, together with the demands for popular information, has resulted frequently in the mere application of old well-established engineering principles to some perhaps new agricultural problem, or in more or less emergency testing work of little permanent value, to meet the immediate requirements of the specific problems in hand. Thus the advancement of the engineering itself has often not been given the consideration it merits.

In short, there has not been nearly as much effort to increase the basic knowledge of agricultural engineering in this country as has been the case with other branches of pure agriculture. There are, however, some well marked exceptions not only in this country but abroad.

Research work in subjects classed as agricultural engineering have included the following:

Materials; Farm Buildings and Fences, or Farm Structures

Farm Machinery; Roads and Bridges

Irrigation; Water Supply, Sewage Disposal and Sanitation

Drainage; Miscellaneous

MATERIALS

The work on materials has consisted mainly of pure research. The work on alkali-proofing of cement and concrete and the preparation of alkali-proof cements at the Wyoming Experiment Station has proceeded to the point at which some definite basic principles are being laid down. The work on roofing materials at the Iowa station appears to have been mainly a comparison of different types of materials. While this does not appear to be research as far as the materials are concerned, it can in a way be classed as research, if the ultimate intention is to establish definite rules for the use of certain roofing materials for certain definite conditions.

Considerable work has been done on timber preservation at the Iowa, California, Pennsylvania, Minnesota, North Carolina and several other state stations. It is difficult to determine the exact status of this work although some of it is undoubtedly research in that its ultimate purpose is the establishment of methods and basic principles of procedure for the state conditions.

Considerable work on materials which is of interest to agricultural engineers has been in progress at institutions not of an agricultural nature, such as the U. S. Bureau of Standards, the Lewis Institute of Chicago and the U. S. Bureau of Mines. There is apparently hardly a building material which has escaped the scrutiny of the Bureau of Standards. (The cooperative project on concrete drain tile has yielded some noteworthy basic information.) We are also indebted to the Bureau of Standards for considerable basic information on metals, particularly steels, semi-steels, cast-iron, brass and bronze, which are used in the manufacture of farm machinery. Data on woods for this purpose are also available and a report was recently issued on the treatment of harness leathers. The work on cements and concrete at the Lewis Institute needs no comment other than to say that the basic principles established not only in the past year but also in previous years at that institution on the proportioning, mixing and placing of concrete are striking examples of the results of true research. It is to be noted that a number of our engineering schools have also conducted some similar work which is of interest to agricultural engineers.

Owing to the agencies at present engaged in research on materials, it would seem that there is little more that can be taken up to advantage by the state experiment stations in connection with structural building materials. However, there is an open field for more research work on metals and woods used in the construction of farm machinery.

FARM MACHINERY

The subject of farm machinery as considered here is very broad and includes not only cultivating and harvesting machines but motors, motor fuels, and power and power-driven appliances in general. It is perhaps the biggest branch of agricultural engineering, has probably seen the most costly experimenting, and from the standpoint of actual research, seems to have been the most neglected.

Many reports of so-called experimental work with farm machinery are available and much of such work is in progress at the state colleges and experiment stations, but frequently such work is conducted entirely by or under the supervision of agronomists. The work in the long run usually resolves itself into simple comparative tests of different types and makes of machines and leaves us in the position of using the best of merely what is available.

*The 1920 report of the A.S.A.E. research and data committee.
**Mem. A.S.A.E., Specialist in Rural Engineering, States Relations Service, U. S. Department of Agriculture.

Aside from the work done by Dr. E. A. White, that by Fischer in Germany and perhaps a few others, there has been very little research conducted on plows since Thomas Jefferson figured out a curve for a moldboard plow, although there has been a lot of costly experimenting. Perhaps such work is not needed but if so, then why all the different types and makes of moldboard plow on the market? We know in a general way what plow to use for a certain type of soil but there are many plowing conditions under which no plow gives entire satisfaction. There are certain rules of thumb about plow adjustments for suction, side draft, etc., but what is the basis of these rules other than fit and try. For instance, the recent tractor trials at Lincoln, England, brought out the fact that plow designers have not as yet put out implements which take into account all the requirements of mechanical traction. We ought to know more about plows, that is, something definite and basic. Undoubtedly plow manufacturers would welcome basic information on plows which would save them costly experiments.

Numerous tests of tillage and tillage machinery have been in progress during the past year but in the majority of cases under the supervision of the agronomy departments, thus making the machinery of secondary importance and merely a means to an end. Such tests have been in progress at the Kansas, North Dakota, Oregon, Ohio, South Carolina, South Dakota and California stations in particular. The Deutsche Landwirtschafts Gesellschaft has also been active in this respect. On the other hand, a step in the right direction are the studies of the draft of farm implements at the Iowa, Montana and Missouri stations, and of the power required for plowing at the California station. Such studies, if carried far enough, should begin to indicate facts of considerable basic importance in design and manufacture.

MUCH TO BE LEARNED REGARDING THE TRACTOR

There is perhaps more known in general and less in particular about tractors than any other farm machine. A recent specification sheet listed some 314 tractors of some 220 different makes on sale in the United States alone. They cannot all be right and it is believed that no one knows whether any one tractor or type of tractor is the optimum of efficiency. The need for research work on tractors to provide some definite and well-established working principles to be used in design and manufacture is reflected, both in the large number of different makes for sale and in the tractor inspection laws which have come into effect in certain states, notably Nebraska. This need was also brought out strikingly at the recent competitive trials of tractors at Lincoln, England, under the auspices of the Royal Agricultural Society of England in cooperation with the Society of Motor Manufacturers and Traders. The official report of the trials expressed doubt as to the desirability of the competitive element in technical trials of tractors until design and construction have reached some definite standard. It is to be noted that machines of American manufacture were active in this competition. Undoubtedly many tractor manufacturers have conducted considerable research as is evidenced by their success. But it is believed that many others have learned only by very expensive experiment and are still in the dark in that they have learned mainly what not to do and very little of what to do.

Most of the work on tractors at the state colleges and experiment stations has consisted either of comparative or competitive tests of different makes or of economic studies. Research into the economics of tractors is undoubtedly of great importance. Its weak point at present is that it must be based on experience with the tractors available and not always on tractors designed and constructed on the basis of firmly established basic facts. It is conceivable that two neighboring farmers may obtain satisfactory results from one design of tractor and unsatisfactory results from another design of the same rating, thus making their economic reports contradictory. Consequently, the results of economic studies of tractors may frequently be of questionable value. In spite of this, considerable helpful data have been secured by the Iowa, Pennsylvania, Kentucky, Florida, South Dakota, Nebraska and several other stations on the economic use of tractors, most of which will serve as a basis for future research in design and construction.

TRACTOR STUDY IN PROGRESS IN MANY STATES

Special engineering studies of tractors have been in progress at the Iowa, Montana, Indiana, California and Nebraska stations. It is believed that the work at these stations more nearly approaches research than that of any other station. The Iowa station has taken up motor cultivation and such matters as traction equipment. It is to be noted in this connection that the Institute National Agronomique of France has entered into a somewhat extensive research on tractors, which is apparently intended primarily to aid manufacturers in the production of tractors satisfactory to farmers. The Society for the Encouragement of National Industry in France is also interested in and is assisting in this work. France has realized the lack of basic knowledge of the tractor and has indicated an apparent intention to place future manufacture of these and also other farm machines on a sound research basis.

About the same general principle applies to work on other types of farm machinery at the colleges and stations. With a few exceptions, most of the work has consisted merely of demonstrations of old principles. A few notable exceptions are the plow draft tests at the Iowa station and the milking machine investigations at the Illinois, Iowa, South Dakota, New York and California stations. Studies of labor-saving machines and fertilizer distributors are also in progress at the Iowa station and of horsepower at the Oregon station.

Attention may well be drawn to an example of methods of research in agricultural machinery employed by the National University of Buenos Aires in Argentina. The work is started by conducting power utilization distribution tests of an agricultural machine. For instance, tests of a series of grain binders showed that 16.5 per cent of the driving power was utilized by the sickle, 7.1 per cent by the reel, and 42.2 per cent by the canvas elevator. Tests of materials are conducted simultaneously, the purpose being to establish basic principles for the materials, design, and construction of a binder giving the highest all-around efficiency for the conditions imposed. Reports have been received describing similar work on threshers and corn shellers. In short, it is the desire of that institution to know something about how these machines should be built rather than to limit their work to obtaining a knowledge of the comparative values of available types.

Farm motors, including tractor engines, need considerable development, especially in view of the motor fuel situation. The U. S. Bureau of Standards has recently been engaged in considerable research on internal-combustion engines, with particular reference to carburetion and ignition and has established a number of fundamental principles relative to points which have heretofore been the subject of much argument. Such work is also in progress at the Kansas and Indiana Engineering Experiment Stations. The work of the

Florida Experiment Station and the U. S. Bureau of Mines on fuels for internal-combustion engines is also noteworthy. The U. S. Department of Agriculture is engaged in research on the production of straw gas for internal-combustion engines. It should be noted that the British Ministry of Agriculture is preparing to establish research on all farm machines.

IRRIGATION

Considerable research on irrigation has been in progress at the state stations during the past year. This subject has had the advantage of years of study and has apparently had ample support. The research spirit has prevailed in irrigation resulting in the putting forth of considerable basic information. The irrigation investigations division of the U. S. Department of Agriculture has as usual been quite active, although apparently somewhat limited as to appropriations. Irrigation investigations have also been conducted during the past year at the California, Nevada, Utah, New Mexico, Colorado, Oregon, Montana, Arizona, Nebraska, Oklahoma and Idaho stations. California has perhaps been the leader in amount and scope of such research. Special studies have been conducted on methods of irrigating certain crops, such as alfalfa, rice, vegetables, vineyards, orchards and small fruits, special attention being paid to soil moisture and duty of water. Duty of water and soil moisture studies have also been in progress at the Oregon, New Mexico, Idaho, Nebraska and Utah stations. The Colorado station has continued its work on the measurement of irrigation water, particular attention being paid to current meters and the venturi flume. The Montana station has also conducted work of this nature. Evaporation and ground-water movement experiments were conducted at the Colorado, New Mexico, Utah, Oklahoma and Arizona stations. Studies of alkali and the reclamation of soils made alkaline through the excessive use of irrigation water were conducted at the New Mexico, Utah, California and Arizona stations. Seepage studies were conducted at the Montana station. Irrigation pumping plant investigations were under way at the California, Nebraska, Utah, and Arizona stations, and in this connection the California station conducted work on the manufacture and use of concrete pipe for distribution of pumped irrigation water. The Oregon station has undertaken studies of the feasibility of irrigation with a view to improving the distribution and use of irrigation water and the state irrigation water laws. The Irrigation Investigations Division has, in addition to other activities, issued three important reports, one on spillways for reservoirs, one on the capillary movement of soil moisture and one on the flow of water through concrete pipe. The two last reports are especially typical of true research. In addition that division has engaged in research on current meters which has resulted in the design of a new and efficient meter.

DRAINAGE

The research work in drainage, while perhaps not so extensive as that in irrigation, has been none the less typical of true research. Most of the state stations have conducted research of one kind or another in drainage and some special reports have been issued by the Drainage Investigations Division of the U. S. Department of Agriculture. Two of these, one on the flow of water in drain tile, and the other on the flow of water in dredged drainage ditches, are especially typical of true research. It is to be noted that the French National Academy of Sciences has also reported similar studies on the flow of water. The work of the Iowa Engineering Experiment Station on drainage and drainage structures is also particularly noteworthy as being typical of true research in drainage.

Drainage studies were in progress during the past year at the California, Colorado, Oregon, Indiana, Arizona, Ohio, Missouri, Iowa, Minnesota, Montana, New Mexico and Alabama agricultural experiment stations. The extent of this work in irrigated areas indicates the growing interest in drainage of irrigated lands. The work in Alabama consisted mainly of the usual swamp and overflow land reclamation which, while not research as a whole, usually entails considerable incidental research. The work at the Indiana station on the effect of drainage and soil moisture on soil acidity, at the Ohio station on the loss of plant food in drainage water, at the Missouri station on water penetration, evaporation, and run-off, and at the Minnesota station on the movement of soil water are typical of true research in drainage in the more humid sections. The work at the California, Arizona, New Mexico and Oregon stations on the drainage and improvement of wet and alkaline soils are typical examples of research on the drainage of irrigated lands. The Colorado station has entered the drainage field with a project on the drainage requirements of crops and drainage factors for Colorado conditions.

FARM STRUCTURES

The subject of farm buildings and fences, or more generally speaking farm structures, received considerable attention at the state colleges and stations during the past year. While considerable of this work was mere demonstration, there was a large amount of work which may be classed as research. Almost every state did some work on silos, but research on silos was limited to the Iowa, North Carolina, Michigan, Missouri, Guam and perhaps a few other stations where studies were conducted of silo wall treatment, silo capacities and general design, based on local conditions.

Research on poultry houses received the usual attention. The New Jersey, Kentucky, California, Utah, Indiana, Maryland, Washington and Idaho stations continued work on their comprehensive poultry house projects, taking up such special questions as artificial lighting in its relation to egg production and improvement in design for local conditions.

Studies of the design of self-feeders for hogs were conducted at the New Jersey, Ohio, Pennsylvania and Arkansas stations. It may stretch the imagination to class such work as research, yet it is evident that these stations had in mind the laying down of basic principles to aid the animal husbandry departments in their work of hog fattening. Closely related to this work was the work at the California station on the design and construction of feed lots. The Nebraska, California and Iowa stations continued their studies of hog-house design. The Iowa station also conducted general studies on equipment for livestock feeding and management and on farm structures in general. A feature of the Iowa work is the study of the efficiency of barn ventilating systems. The Indiana station has also had a rather comprehensive project in operation studying the representative types of farm buildings in the state in an effort to lay down basic principles for the state conditions. The California station was engaged in studies of the design of beef and dairy barns and also of houses or hutches suitable for use in raising rabbits. The Oregon and California stations engaged in studies of equipment and structures for the handling, storage and preservation of manure. The work of the French Institute National Agronomique on farm structures is also noteworthy, especially that recently in progress on structures to meet the emergency conditions in the devastated regions. The analytical methods em-

ployed by the French engineers may well be given consideration.

ROADS AND BRIDGES

Practically no research work was done on roads and bridges by the state agricultural experiment stations, as this work is for the most part handled by the highway commissions of the different states and by the U. S. Bureau of Public Roads. No information was secured regarding research by these institutions on the subject other than that contained in their publications. Further mention will not be made of this branch of the subject except to include the more important publications in the data references, and to note that the Chief of the Bureau of Public Roads recently indicated the growing need for research in highway problems.

WATER SUPPLY, SEWAGE DISPOSAL AND SANITATION

The subject of water supply, sewage disposal and sanitation has received very little research treatment. This also includes lighting, heating and ventilation. This is one of the subjects in which it is believed we have offended the most by attempting to teach without basic knowledge. Only a few public institutions seem to have recognized that fact. There is abundant literature on the subject with new additions coming in every day, yet practically none of it contains anything new. An instance occurred recently in which a state board of health recommended procedures in water purification which had been described by the Federal Government some eight years before, and subsequently through necessity materially modified.

A number of our public institutions in response to popular demand are continually putting out literature descriptive of methods and apparatus for the disposal of sewage, the purification of water and other sanitary processes, frequently without any apparent substantial basis other than perhaps inadequate experiment.

The U. S. Public Health Service has sounded a warning in this connection, and has condemned a number of the practices which have been recommended by other institutions without a knowledge of basic facts. That Service has had a project on residential water supply and sewage disposal in operation for some years, and only recently has it begun to lay down basic principles.

The Missouri, Montana, Michigan, New Jersey and Idaho stations, the New York State College of Agriculture, the Iowa, Kansas, Indiana, Oregon and Washington engineering experiment stations, and a few of the state boards of health, especially those of Minnesota and Ohio, have apparently been taking steps along the same line. The New Jersey station is making a special study of the biology of sewage filters. The Wisconsin station seems to have continued its comprehensive project on the disposal of creamery sewage and the Michigan station has taken up a study of dairy sanitation.

The need for research on this subject is reflected in the attitude of some of the foreign agricultural institutions, especially those in Holland, Germany, France, and in some of the tropical protectorates. A project of this nature was recently begun in the Dutch East Indies by a comprehensive study of the gases formed in septic tanks and the relation of gas formation to the design of systems which purify sewage, the purpose being purely and simply to establish basic principles. It is evident that while plenty of mechanical principles are available for use in rural sanitary engineering, there is a need for research to establish basic working relations between sanitary and mechanical principles to meet specific classes of conditions.

MISCELLANEOUS

Considerable research of a miscellaneous nature has been under way. The Idaho, Oregon, Minnesota and Wisconsin stations and perhaps a few others are engaged in conducting comprehensive land clearing investigations, and the Idaho station is investigating the utilization of logged-off lands. In this connection a very neat piece of pure research was conducted and recently completed by a private explosive manufacturing company at the suggestion of the States Relations Service of the U. S. Department of Agriculture, on the removal and utilization of pine stumps from logged-off lands in one of the southern states. Of course, this company was primarily interested in the use of explosives for the removal of stumps but the researches showed that the stumps after removal could be distilled and made to yield products of sufficient value to pay for the removal, distillation equipment and all expenses, and yield a new revenue on the whole project, in addition to leaving the land cleared ready for cultivation. The basic principles of this process were established and preserved and are now available for practical use. The Ohio and Arizona stations conducted work on the use of dynamite in the preparation of soil for crops and the Wisconsin station on the use of dynamite in tree planting and T. N. T. for general blasting.

The South Dakota station continued its work on ice-making on the farm, the Kansas station its milling investigations project and the Iowa station the study of soil erosion and preventive measures therefor.

CONCLUSION ON RESEARCH

This review shows that in spite of circumstances tending to discourage research, there has been considerable pure research in agricultural engineering at the state agricultural experiment stations and other institutions during the past year. It is known that many of the state stations have not only been seriously handicapped through lack of funds for research work, but also through lack of suitable personnel. Many of the more capable research engineers have given up research work to take better paid positions in other lines. Such a situation is a serious one from the standpoint of the permanency of agricultural engineering accomplishment.

Every phase of agricultural engineering should be based upon the results of careful research to give both satisfactory and permanent results. It is not within the province of this report to outline methods of procedure in individual research projects, but it seems advisable to call attention to some of the important points brought out in a recent editorial appearing in the Experiment Station Record (Vol. 43, No. 4) on research projects in agriculture. It is pointed out that a project in agricultural inquiry is first of all a constructive scientific undertaking which aims to advance science and through it the art. Its purpose is "to find out and learn how," and thus to understand the purport of results obtained. It deals with things that are fundamental, aiming to disclose the underlying principles or conditions of relationship and seeking to develop basic facts and establish their universality. Originality in research implies going outside of what is known or practiced and injecting something new in purpose or procedure. The scientific method of advancing knowledge is the substitution of detailed and verifiable results for broad, unproved generalities derived from practice or from inadequate experiment and speculation. A research project should have a definite aim and should be progressive in its conception and its conduct, proceeding in a systematic and orderly way from one essential point to another. Owing to its nature

it is necessarily restricted in scope. It always looks toward completion and should be planned with this in view. It is recommended that wherever possible, future work in agricultural engineering be planned with these points in view.

AGRICULTURAL ENGINEERING DATA

It has apparently been the desire of the Society to combine the subjects of research and data into one committee. While they are two separate and distinct subjects, yet they are closely related and dependent upon each other. Research yields basic working data and general data is indispensable in research. This Society has long been talking about a data book. One of the main aspects of research is to determine the purport of data at hand. There is a large amount of data available of one kind and another related to agricultural engineering.

There is appended a list of selected references to agricultural engineering data obtained in the course of conducting the rural engineering section of the Experiment Station Record. These references have been selected on the basis of their research value and should be added to the list of references submitted in the report of the data committee last year.

As pointed out in last year's data committee report, the work of preparing a handbook is not only large but endless. Since the Society now has a monthly journal for its proceedings, it is recommended that the research and data committee for the coming year be authorized to submit monthly to the editor of AGRICULTURAL ENGINEERING sufficient data in complete working form to fill at least one page, and that the editor be authorized to arrange and print such data in each issue of the Journal in such form that it can be conveniently cut out by each member and inserted in a loose-leaf binder. In this connection it is recommended that the editor be referred to the suggestions of the 1918 data committee as to size and shape of data sheets, and that he be authorized to modify such size and shape to conform to the requirements of the Journal, but consistently with good practice as regards pocket loose-leaf data books.

EDITOR'S NOTE: Space limitations do not permit the publication of the list of references to agricultural engineering data mentioned in the next to the last paragraph. This list, however, will be published in the transactions of the Society.

Artificial Heat for Animal Shelters*

By K. J. T. Ekblaw**

WHETHER the heating of animal shelters by artificial means is desirable is a debatable question. However, wherever a difference of opinion exists, there is an opportunity for making a decision one way or another. In this paper no attempt will be made to arrive at such a decision, but a few ideas and their practical application will be presented for what value they may possess.

Nature certainly did not calculate that wild animals, existing in regions of cold would need anything in the way of artificial heat; but the conditions which Nature took into consideration have been changed by the process of domestication of certain of these animals. It may be that ultimately it will be found that domesticated animals will thrive better without artificial heat, but it does seem that in the present state of their development a little artificial heat, applied under proper conditions, may be beneficial. It has apparently been proved that heat is detrimental to the thrift of poultry except in the chick stage. Sheep that have been brought up under unusual protection suffered severely when exposed to unusual cold and most sheep raisers believe that the only shelter should be from rain, snow and wind.

In Bulletin No. 152 on "Swine Houses," issued by the Iowa Agricultural Experiment Station, Prof. John M. Evvard, one of the foremost authorities in America on swine, makes the following statement:

The newly farrowed pigs especially demand protection. Early pig production is impossible without warm shelter. Stock hogs thrive best when they are not compelled to shiver from cold and thus burn up feed which would otherwise be converted into tissue. The wintering sow makes use of a warm sleeping bed. In truth all classes of swine demand reasonably warm shelter if maximum returns are to be expected."

This statement summarizes admirably the needs and reasons for keeping swine houses warm. Of course in warm climates, such as obtained in the southern states, the sun's heat combined with bodily heat of the swine themselves is sufficient to meet requirements. Proceeding north, however, into states where the length of winter and the intensity of the cold becomes greater and greater, the need for a more adequate provision against cold becomes evident. Through the states of Ohio, Indiana, Illinois, Iowa, Missouri, Kansas and Nebraska, which comprise in the main the great "Corn Belt," and in which are grown and fed the enormous number of swine utilized by the packing industry in its operations, the winter is sufficiently long and severe to bring hardship upon unprotected swine.

Something more than natural heat is necessary. Artificial heat, which can be produced and controlled regardless of the severity of weather conditions, renders the swine raiser independent of the latter. The heat supply can be governed to meet requirements, and thus there need be no wastage.

Swine house construction, on farms where attention is given to swine raising, is rather substantial. The house itself is almost always of a single story with a rather low roof. The walls, if of wood, are usually double, sometimes with an additional thickness of building paper between the layers of boards. The construction of masonry swine houses, using a hollow clay or concrete block, is becoming increasingly common. Precautions are taken to render the construction of the building as close and tight as possible, consequently there is a minimum of heat loss. Most houses are constructed so as to front toward the south and this side is well supplied with windows to obtain the full effect of the warmth of the sun's

*Paper presented at the annual meeting of the American Society of Agricultural Engineers held at Chicago, December 28 to 30, 1920.

**Mem. A.S.A.E., farm engineering editor, The National Farm Power, Chicago.

rays and to utilize them for as long a period as possible. Tables have been prepared by the United States Department of Agriculture (Farmer's Bulletin No. 438) indicating the proper location of windows to get the greatest benefit from sunshine.

In general construction, and therefore in amount of heat lost from the walls, swine houses may be considered similar to factories. Both possess simple but substantial wall construction, and both have a large proportion of the walls consisting of glass. The coefficient of heat transmission is given by Greene as the same for a double board wall and for a 12-inch brick wall, being in each case O. 31 B. t. u. per square foot per hour per degree difference in temperature.

In general, it is of course not necessary to maintain in a swine house a very high degree of temperature; in fact, 60 degrees may be considered a reasonably satisfactory temperature for swine, for even with the somewhat inadequate provision against cold given them by Nature, they are to some degree resistant to severe weather conditions.

Since there are no strongly voiced objections to heating swine houses and since practically all authorities approve of it and general practice favors it, the questions that come up are those of decision as to the most satisfactory type of heating systems and how such a system and the operation of it will accommodate itself to the general conduct of farming operations.

To answer the last question first, it may be said that on farms where swine raising is of consequence, the swine require regular attention for feeding, dipping, cleaning the house, etc., and the small amount of attention which a heating system requires can easily be incorporated into the regular duties of the attendant. The amount of heat required is not exceedingly great so that a comparatively small system will suffice. Then, too, most swine raisers feed cooked ground feed to swine, and do not consider the work in connection with this to be at all onerous, so that no objection to the duties of caring for heating system can be legitimately raised. It may be possible in many cases to combine efficiently the processes of heating and feed-cooking so that a single heater may be made to serve two purposes.

From a consideration of the conditions involved, it seems that either a steam or hot-water heating plant would fill the requirements most satisfactorily. A warm air system is not entirely practicable because of the greater difficulty of heat distribution, for most swine houses are long low structures and an economical and efficient arrangement of ducts for transmitting the heated air cannot very well be devised.

To illustrate the application of heating principles to swine houses, a standard steam system will be designed for a typical structure and a layout of the design shown.

The house illustrated is what is commonly known as the "half-monitor type," the design of which has been perfected by Prof. William Dietrich, formerly of the Illinois Agricultural Experiment Station. The pens are arranged in two rows, one on each side of a central passageway, which may be made wide enough for a horse-drawn wagon to pass through. The house is always built to front to the south to get the maximum sunlight, and both rows of pens are arranged so as to receive sunlight. In the monitor wall, double-hung sash are located the entire length of the building, and ventilation on warm days, or whenever necessary, is made possible by controlling the opening of these windows. The typical house, as illustrated, is 22 feet wide, 6 feet high at the eaves both front and back, and the high studs in the monitor wall are 14 feet long. The length of this particular building is 48 feet, though of course its capacity can be changed as desired by changing its length.

The well-known Mills rule will be used in calculating the amount of radiation required:

$$\text{Feet of radiation} = \frac{v}{200} + \frac{w}{20} + \frac{g}{2}$$

V = volume in cubic feet
W = exterior wall surface, including roof, in square feet
G = exterior glass surface in square feet
In this particular house,
V is approximately 8500 cubic feet
W is 2016 square feet
G is 264 square feet

Substituting these values in the preceding formula, it is found that the required feet of radiation is 284.9. Since the Mills rule contemplates a difference between inside and outside temperatures of 70 degrees while but 60 degrees is considered in the swine house, the amount of radiation actually necessary is but six-sevenths of that indicated by the Mills rule, or 235 feet. As a check on this calculation a determination of the actual heat loss may be made and from this the radiation can be figured. Using 0.31 and 1.0 as values of

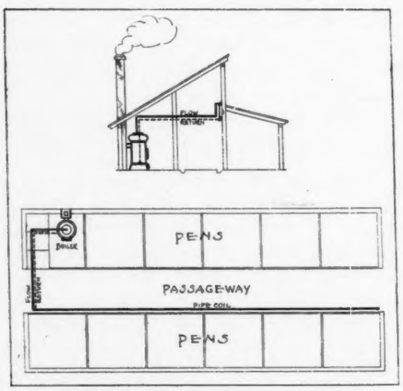


Fig. 1. Suggests arrangement for heating plant in a swine house

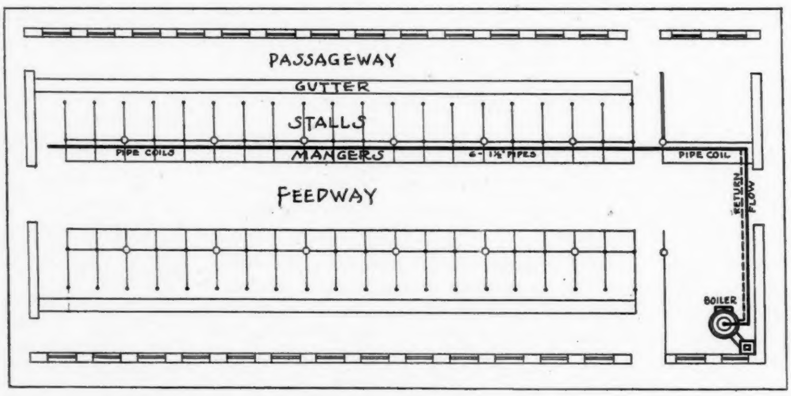


Fig. 2. Plan view of a steam heating system in a typical dairy barn, worked out in accordance with principles laid down in the paper

heat loss coefficient for the walls and glass respectively, the following is obtained:

$$2016 \times 0.31 \times 60 = 37500$$
$$264 \times 1.0 \times 60 = 15840$$
$$\text{Total heat loss per hour in B. t. u.} = 53340$$

Since the condensation of one pound of steam liberates 970 B. t. u., and since one foot of radiation condenses approximately ¼ pound of steam per hour, the radiation necessary is

$$53340 \div \frac{970}{4} = 222 \text{ feet}$$

which approximates the result obtained by rule.

It is obviously impractical to use ordinary radiators in a structure of this type; much better distribution of the heat can be obtained by using ordinary pipe coils connected directly with the boiler and extending the entire length of the building. From a table of data on wrought iron pipe given by the manufacturer, it is found that one foot of 1½-inch pipe has a radiating surface of 0.50 square feet. To provide 235 feet of radiation, 470 feet of pipe is required, or the equivalent of ten pipes each 47 feet long. Consequently, our heat coil would consist of these ten pipes properly connected with return bends.

The location of the coil may be made wherever it is most convenient. At the rear of the house, on the upper part of the rear wall, might be a satisfactory place, but perhaps a more advantageous location is just below the windows of the monitor wall. This location would aid in the better distribution of the heat.

The smallest boiler manufactured would be large enough to take care of the necessary 235 feet of radiation. Referring to the catalogs of two of the largest manufacturers of heating apparatus, it is found that the smallest boiler has a rated capacity of 300 feet of radiation. This size would then be amply large and would have a reserve capacity for emergency conditions.

In most of the well-known European dairying centers—the Channel Islands, Scotland and England, the Netherlands, Denmark —a deeper appreciation of animal comfort is found than is prevalent in America. In the old country it is quite common to find the cattle housed under the same roof that shelters their human caretakers; and any comfort in the way of heat is shared by both. American ideas of the propriety of housing conditions are, however, essentially different from those of Europe, and cattle are consequently isolated and sheltered in separate structures. With this change in conditions, though Americans feel fully the need of heat in their own habitations, they seem to forget that backs other than their own might become cold, and it is indeed the rare exception to find any sort of a stock shelter supplied with artificial heat.

In pioneer days, shelters of any kind, whether for humans or animals, were not built exceptionally well. Later, as conditions became better, more substantial residences were the rule, and now the improvement has extended to the stock shelters as well. The modern dairy barn, from the standpoint of construction, is almost all that could be desired; it is roomy, solidly and substantially built, and possesses beauty and simplicity in an architecture all its own.

Heating a dairy barn is a proposition that may appear of doubtful value, but nevertheless it has been practiced with good results in a number of large estates that could afford to make the experiment; the Wisconsin Agricultural Experiment Station also advises that if it is possible to maintain the interior temperature of a dairy barn at about 50 degrees Fahrenheit, milk production will be increased and will be more easily kept at a maximum. This is an entirely logical conclusion, considering the cow as a machine, and her feed as raw materials and fuel: The less that need be used as fuel to maintain the body temperature the greater will be production.

One advantage which would accrue from the installation of a heating system would be a possibility of its use in heating drinking water for cows during the winter months. In order to produce large quantities of milk cows must drink large quantities of water. The New Jersey agricultural experiment station states that a cow giving 12 quarts of milk per day needs 36 quarts of water, and the assimilation of the nutritive elements of one pound of corn is required to raise the temperature of the water from freezing to the normal body temperature. It is easily seen that with a herd of forty cows, the cost of warming sufficient water is a considerable item, and it is recommended that use be made of a heater for the sake of economy. When water is warm the cows will drink much more of it and the digestive condition of the animal will not receive the chill and shock as is the case where the water is icy cold.

An up-to-date dairy barn, such as is found on dairy farms throughout the country, is a structure of brick, or stone, and wood; with concrete for floors, mangers and, very often,

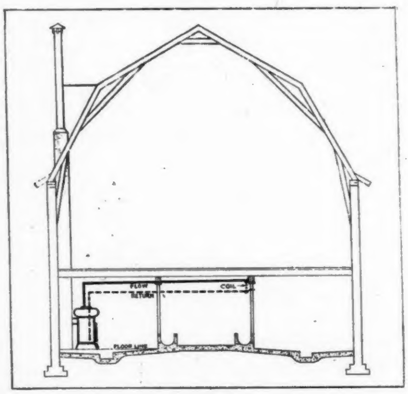


Fig. 3. Cross setion of dairy barn showing location of steam pipes

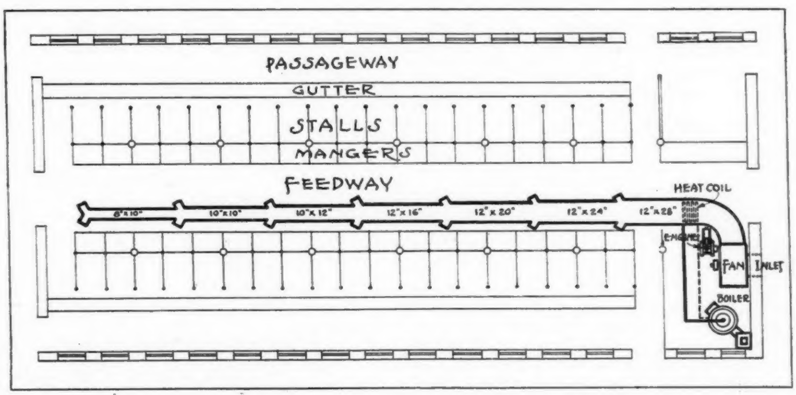


Fig. 4. Plan view of dairy barn provided with combination of warm air heating from steam coil and forced draft ventilation

walls; sometimes the entire structure is built of fireproof materials, with masonry foundations, walls, piers and floors, and with steel arches supporting a roof of metal or asbestos shingles. Every provision is made for strength, reasonable durability, sanitation and for convenience in operation, so that the installation of some means of providing for the maintenance of a moderate degree of artificial warmth completes the list of requirements for an exceedingly efficient factory.

The particular dairy barn which will be used for purposes of illustration is of the type that is quite commonly used, known as the "plank frame" type in contradistinction to the "timber frame" type. The walls may be of double boards or masonry, the mow floor is of matched flooring, and since in the winter time the mow is piled full of hay, the heat loss through the mow floor is practically negligible.

The barn, as shown, is 36 feet wide and 80 feet long. Barns of this type have been built 200 feet or more in length. The ceiling, which constitutes the mow floor, is 9 feet high. Stalls are provided for 38 cows with additional enclosures to be used as calf or bull pens. An abundance of light is provided through 30 windows, each holding four 14 by 16-inch panes.

For the purpose of illustration, the essentials of a design of a steam-heating system will be briefly outlined, with the boiler located in one of the end rooms and with the pipe coils hung on the interior posts above the mangers.

The following data is calculated from the dimensions of the barn and windows given above:

Volume ....25820 cu. ft.
Exterior wall surface.......... 2088 cu. ft.
Exterior glass surface......... 240 cu. ft.

Using Mills rule for the determination of the amount of radiation required,

$$\text{feet of radiation} = \frac{25820}{200} + \frac{2088}{20} + \frac{240}{2} = 350$$

This is based upon the assumption that the building is to be heated to a temperature of 70 degrees with an exterior temperature of zero degrees. However, as has been previously stated, the desirable temperature in a dairy barn is about 55 degrees, and it is entirely reasonable to assume that the heat from the bodies of the animals themselves will account for an increase of 5 degrees; so that a temperature difference of 50 degrees is what should really be considered, which will reduce the radiation by $\frac{70\text{-}50}{70}$, or 2/7, making it 250 feet instead of 350.

Using 1½-inch pipe, which affords 0.5 feet of radiation per foot of length, it is readily seen that a total of 500 feet of pipe will be needed. Six pipes 80 feet long, properly connected by return bends, together with the pipes connecting the coils and the boiler, will furnish the radiation required. As in the swine house, the smallest size of boiler manufactured will be amply large to meet all requirements, besides furnishing enough additional steam for sterilizing milk utensils, for heating water for cleaning purposes, etc. The layout of the system is shown in the plans. For the purpose of avoiding danger from fire as much as possible, the boiler room should be plastered or lined with brick, and great care should be taken to avoid the collection of any kind of litter near the boiler.

In systems of ventilation that are generally considered in connection with farm buildings, circulation of air is caused either by increase or reduction in pressure by the force of the wind or by expansion due to heat. The former is of course unreliable and variable, and the latter being the feeble force is likely to be destroyed by badly constructed flues, by uncontrolled wind currents, or by friction. A positive method of producing a certain circulation of air is to employ a fan or blower of some character, operated by mechanical power, which would be strong enough not to be affected by adverse influences.

Since in a system of this kind the air is taken from some source by the fan and distributed by the force of the fan through a system of pipes, it will be a very simple matter to combine with the ventilating system an excellent heating system, using the air as a medium for the transmission of the heat. The same distributing system, and the same motive power can be used, the only additional provision that is necessary being that for warming the air before it is distributed.

To exemplify this method of combined heating and ventilating, a system will be designed for the dairy barn previously described.

According to King, who based his determinations upon actual tests, the amount of air required by animals is as given in the following table:

Kind of Animal	Cubic feet of Air Required per minute
Horse	70
Cow	60
Hog	23
Sheep	15

In the barn described, there were stalls provided for 38 cows, with an additional open stall; it would be reasonable to figure on a maximum of 40 head of cattle, requiring $40 \times 60 = 2400$ cubic feet of air per minute, or 144,000 cubic feet per hour, which must be forced through a heater that will raise its temperature to 55 degrees in zero weather, and distributed within the barn.

Carpenter, in "Heating and Ventilation," states that a "heater provided with blower will condense under average conditions 2 pounds of steam per square feet of surface per hour." The heat given up by the condensation of 2 pounds of steam is $970 \times 2 = 1940$ B. t. u. If one B. t. u. warms 55 cubic feet of air one degree, to heat one cubic foot 55 degrees will require one B. t. u., and to heat 144,000 cubic feet 55 degrees then requires 144,000 B. t. u. To furnish this amount of heat, as many pounds of steam must be condensed as 1940 is contained in 144,000 or 78.25, and since a square foot of radiation condenses 2 pounds of steam per hour, $78.25 \div 2 = 39.12$, or practically 4C feet of radiation are required. This is equivalent to 80 feet of 1½-inch pipe, or using "Standard" pin radiators made by the American Radiator Company having a heating surface of 10 square feet, eight sections would be required. The size of boiler to heat these sections is the minimum size manufactured, and there would be an ample surplus to take care of extra requirements.

In determining the size of blower required, the first consideration must be given to the speed at which it rotates, for if it be driven faster than 250 r.p. m., it will make an objectionable noise; 200 r. p. m. is better. Experience has shown that 2,000 feet per minute is a desirable velocity for the flow of air through the ducts. If a blower discharges into the open air, with no interference, it will discharge the air at a velocity even greater than the peripheral speed of its blades; but the transmission through coils and pipes reduces this considerably. With this data, the outer circumference of the fan is $2000 \div 200 = 10$ feet, making the diameter of the fan 3 feet 2 inches.

The resistance which the air will meet, in this installation, in passing through the pin radiators and approximately 100 feet of pipe, will be practically the equivalent of 1 inch of water, or 0.5 ounce, and the fan must deliver the air against this pressure.

The driving power for a fan may be a small gas engine, or an electric motor, depending upon which power is best available. The adaptability of either the engine or motor to this purpose is unquestioned. A 1-horsepower engine, or a ¾-horsepower motor should be amply large.

For the purpose of designing the horizontal ducts by which the air is distributed through the building, a velocity of 1000 feet per minute can be allowed; since 2400 cubic feet per minute must be carried the cross section of the duct must be $2400 \div 1000 = 2.4$ square feet. A rectangular duct 12 inches by 28 inches would be installed, with outlets along the sides, and the duct reduced in size as outlet after outlet is taken off from it. The duct is carried along the ceiling of the central passageway of the building, suspended from the joists.

The Farmer's Engineering Problems*

By J. R. Howard**

ANYBODY that runs a farm or heads an organization like the American Farm Bureau Federation and builds it from the ground up is entitled to be called an engineer.

Whenever anything occurs connected with our organization or with any farming problem, I inevitably turn in my mind to my Iowa farm. I cannot get away from it for fifteen minutes of any day of my life or in any phase of the varied activities in which I engage. I sometimes wish I could and sometimes I am glad I can't, so when the invitation came to address the agricultural engineers, I turned to that Iowa farm. I wondered what I knew or what I had on that farm that would concern an engineer or an agricultural engineers association.

I began to think of the barns and the fact that I wanted, as soon as I can get rid of my present job and go back, to build a new dairy barn, and I immediately saw where I hitched up with engineering. Then I thought of how I was going to build another silo, and I wondered if it would be possible to improve either in location or design on either one of the silos which I have; and there was an engineering problem. I thought of some of the machinery which I have on the farm and some new pieces which I would like to have, and there was an engineering problem. I thought about hauling that machinery out from town in the wagon or wondered whether I should get a truck; and there was an engineering problem. And everywhere I turned, whether to buildings, or tile drainage, or machinery, or livestock—livestock is animal husbandry because it takes barns and equipment to take care of it—I ran into an agricultural engineering problem, and I at once made up my mind that this body of men holds a very important place in the agriculture of America—very much more so than I had thought until the invitation came to meet with you.

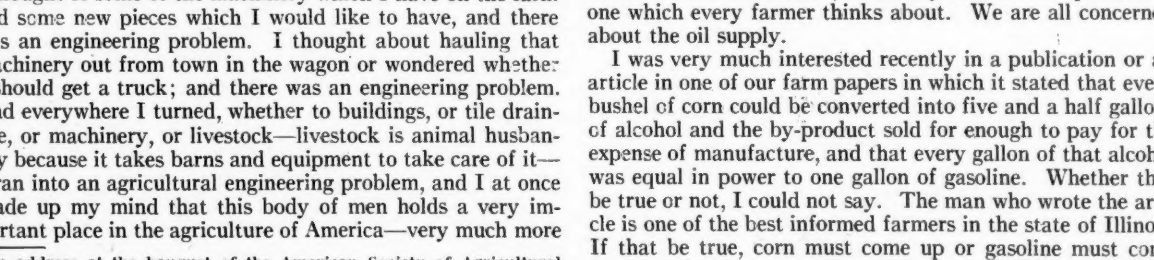
The matter of tractors was suggested by your toastmaster. It chances that I have a tractor. Sometimes I am glad of it, I am delighted with it, it is exactly what I want and maybe in five minutes I will wish I had never heard of a tractor.

There has been a very great increase in the number of tractors within the last two or three years due, as you know, to the necessity of pushing the work on the farm more rapidly because of scarcity of labor and because of the high price of feed. I am unable to keep a horse on the farm without using at least four acres of ground every year to raise the feed which that horse eats and it is a question whether the horse is worth it or not compared with the tractor. It has been a question; it is not a question now. With the present price of machinery and the present price of feed, the horse has it. We need not think otherwise for a moment but the present conditions are not going to prevail always. Tractors must come down to the level of other commodities or feed must come up to its proper level. Perhaps there will be an action in both directions. In that connection, let me say that the fuel problem is one which every farmer thinks about. We are all concerned about the oil supply.

I was very much interested recently in a publication or an article in one of our farm papers in which it stated that every bushel of corn could be converted into five and a half gallons of alcohol and the by-product sold for enough to pay for the expense of manufacture, and that every gallon of that alcohol was equal in power to one gallon of gasoline. Whether that be true or not, I could not say. The man who wrote the article is one of the best informed farmers in the state of Illinois. If that be true, corn must come up or gasoline must come down in either event solving the power problem to some extent. There are some problems, of course, in the use of alcohol as fuel. It must be made more volatile than it is, it is

*An address at the banquet of the American Society of Agricultural Engineers held during the fourteenth annual meeting, Chicago, December 28 to 30, 1920.

**President of the American Farm Bureau Federation and an honest-to-goodness Iowa "dirt farmer."



generally conceded, and it must be denaturized by some substance that is so like the alcohol itself that the denaturizing substance cannot be removed before it comes into the farmer's possession. After that it won't make so much difference. So these various problems are coming up all the while along with the general economic problems.

The president of one of the large city clubs called on me today and my mind went back to the farm. We were talking about the general prices and economic conditions which are confronting the farmers at this time. We did some figuring in our office recently on the price of some certain commodities. One of those was the price of hides and leather products. We tried to figure out whether it would be possible to get a wagon strong enough and a team big enough to haul enough hides to market to pay for a set of harness, and we did figure out conclusively that there is not a man in Chicago—at least, we don't think there is—who, if he had hides to market at this time, would be able to carry a sufficient number of pounds of hides across the street to pay for one shoe—just one moderate priced shoe. Before the war or during the war, that was not quite the case. At the price at which hides sold two years ago, a man could carry enough across the street to buy a pair of shoes but now he cannot carry enough to buy one single shoe.

The price of farm commodities has gone down out of all proportion to the retail price of the manufactured articles. What I told you of shoes is true of all kinds of fabrics and practically every other commodity. You men who are interested in machinery may well take note of those facts, and rest assured that unless there is a change in the buying power of the farmer's dollar, there will not be as much machinery sold next year as has usually been sold to the farmers of the country.

I haven't heard of any definite price schedules on machinery. All I have heard is that the price cannot be reduced. Since there are no reporters present, let me tell you confidentially that there will not be much machinery sold if that be true, unless, of course business revives so that the purchasing power of the farmer's dollar is greater than it is now.

TRANSPORTATION PLAYS IMPORTANT PART

Take on the matter of transportation, for instance, the farmer for years fought railroads rather to his own detriment. He fought for lower rates and lost sight of service. The reaction came and it has come with a vengeance that it is going to concern very vitally every business in this country. You judge the farmer's prosperity, I presume, by the price of commodities on the Chicago market. You forget that the farmer does not receive the Chicago quotations for that which he sells. He receives the Chicago quotations minus the carrying and sales charges, and that carrying charge on grain alone from the average farmer in the grain belt—and that would be in the vicinity of Western Iowa or Minnesota or Northwestern Missouri—penalizes the farmer on the recent rate advance at least ten cents a bushel on every bushel of grain which he sells. Now with the terrific drop in prices on the Chicago market, take the old margin when the price was high and add to that margin an extra ten cents which merely takes care of the recent freight advance and subtract that from the present prices and you will see why the purchasing power of the farmer is gone.

I well remember the conditions which confronted agriculture in 1894 or 1895. That was when corn went to ten and eleven cents a bushel. I had earned my first money during that time or just a year or so preceding. I had gotten together a couple of hundred dollars and bought some lumber and built a corn crib and I speculated in corn at ten and eleven cents a bushel. I knew the condition of those farmers from whom I bought that corn very well and I know the conditions of the farmers in that same locality today, and the condition is infinitely worse today than it was in the days of that ten and eleven cent corn. Why? Because the cost of production is so very much higher now than it was then.

Half of the farms in the best agricultural states are in the hands of tenants. The tenant is usually a fellow who, like myself, began working by the day or by the month on a farm. Finally he got a little money together and bought a team of horses and some machinery, and probably some second-hand machinery at that, and rented a farm. He did not have capital enough to buy the necessary feed and supplies to go through the first year, and being a beginner, he could not rent the best farm. He had to prove his worth before he could get on a good farm, hence, his progress was slow. Finally, if he had the right stuff in him, he would get together a few hundred or two or three thousand dollars. If his ambition was to become a land owner, he would put his small earnings as a renter into a farm, making only a small payment, and the previous owner would take a back mortgage. That is the condition at the present time and has been for years.

LOW PRICES HARD ON FARMER STARTING OUT

These men who have recently bought their farms and have only paid a quarter or a third of the purchase price—and there are thousands and tens of thousands of cases like that—or the renter who is just starting out and has insufficient capital, are in a serious condition. I was out home two weeks ago and talked with some neighbors of mine who are renters—men who had good equipment of machinery and horses, and some cattle last spring—and they tell me they are forced to sell everything they have and then they cannot pay their debts and they are going to have to go to work by the month or go to the city to get employment. I will say without any fear of successful contradiction that more than one-fourth of the farmers of this country today cannot pay their debts, so serious is the situation.

I do not blame all of that, of course, to transportation. Part of it is due to transportation. I am not blaming the railroads, they were entitled to a raise and we conceded they should have it, but we feel they got, probably at that time, a little more than their just desserts, and we feel that if agriculture is to continue to develop in this country, there must come very soon a better balance or adjustment between the farm interests and the other interests of this country.

If I was supposed to talk about tractors, I got off of my subject. The tractor has come to stay, there is no doubt of that in my mind. The problem of the tractor manufacturer is to make it not as cheap as possible for a cheaply made machine made cheap at the expense of durability and service, is false economy always, but to make it as durable and as simple as possible and designed to meet the hard strains which a tractor must bear.

The difficulty with the tractors—I am speaking now from my observation of my neighbors, not my own experience—is that just in the rush season when they need that machine more than at any other time, something goes wrong with it and they have to send and get a garage man to come out, and the average automobile mechanic does not know much about a tractor because there seems to be a vital difference in the mechanism of a tractor and that of an automobile.

They are made for very different purposes and the automobile expert is not a tractor expert, hence the farmer does not get very good service.

I don't know whether you ever run into that proposition or not. Then, if anything is wrong, it is necessary to send it to the factory or maybe get a man to come out from the factory to put those parts in place. If the tractor becomes an absolutely successful and reliable tool, it is going to be because it is made as simple as possible to get service out of it and every part made as accessible as possible so that the farmer can do a good deal of the repair work himself, for he cannot depend upon high-priced expert work. If he does, he will soon discard the old tractor and the tractor company will have a bad reputation in that community, so it is to your interest as engineers to make those tractors as durable and as simple as you can, and then as tractor manufacturers or as truck manufacturers, go just as far in standardizing those machines as you possibly can. I would like to see all of our leading farm machines standardized. I am aware of the inconvenience that the dealer would experience for a short time, because he would have to keep the various lines of repairs until the old machines now in the hands of the farmers are cast aside which would be five or ten years, but when that time is gone, there would be a very great advantage in standardization.

Now the truck business and the tractor business is in its infancy and you have a chance to begin that standardization without the excuses for non-standardization which implement manufacturers are now making, and I urge you by all means to standardize as rapidly as you can.

Everything which you as engineers have to deal with comes from the soil. If it does not come directly from the farm, it comes indirectly from the farm. If it were not for the farm, you could not produce. There would not be factories or transportation or merchandising or labor were it not for that farm service. If by any chance the surplus from the farms of this country should decrease ten or twenty-five per cent, there would be a proportionate decrease in the number of freight cars and freight trains which run on the roads; there would be a proportionate decrease in the number of men employed in the factories in this country, and there would be a decrease in all kinds of production. According to the law of supply and demand, that would mean probably an increase in the price of those commodities.

The farmer wants labor well and usefully employed. He wants trains to move and factories to run and he knows in order to bring those things about he must increase his production and maintain that increased production. You men are vital agencies in assisting us to bring about that increased production which is essential to your interest and our interest and the interest of this whole great American nation of which we are a part.

Making A Tractor Drawbar Test

By E. V. Collins*

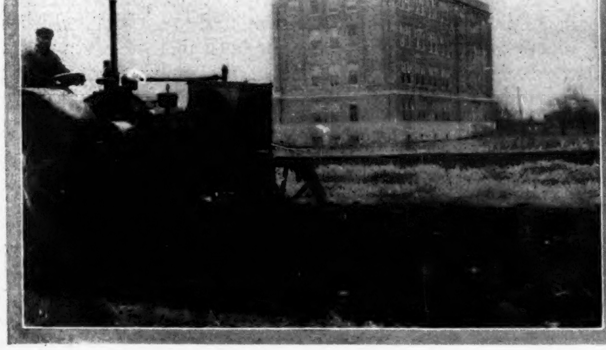
ANYONE who has attempted to determine the maximum drawbar pull of a tractor by the use of a dead load realizes that it is very difficult to apply the maximum load the tractor can pull without stalling or digging in. This necessitates relieving the load in making a new start.

The writer has been using a slow-moving tractor as a load and finds it quite satisfactory. The tractor used as the load is slowed down until the governor on the tractor being tested is wide open, or until there is excessive slippage of the drive-wheels, either of which indicates that the maximum pull is being exerted.

Where the tractor being used as a load is not much larger than the one being tested it will be necessary to use the brake on the rear tractor, or add some sort of load such as a plow or disk harrow.

The dynamometer is connected directly to the tractor being tested and a rope connects to the rear tractor. The writer first used a steel cable for this connection, but it is almost impossible to avoid severe jerking when starting up. With 40 or 50 feet of rope there is enough elasticity to absorb any shocks caused in starting. A 1½-inch rope is used with ferrules spliced in the ends to prevent cutting the strands.

*Mem. A.S.A.E., assistant chief agricultural engineer, Iowa Experiment Station.



USING ONE TRACTOR AS A TEST LOAD FOR DRAWBAR PULL OF ANOTHER
The apparent lack of alignment arises from the necessity of taking separate photographs of the two ends of the outfit. The rear tractor is not dead but running, the amount of load put on the front tractor depending on the extent to which the tractive effort is reduced by throttling the rear engine

AGRICULTURAL ENGINEERING

The Journal of the American Society of Agricultural Engineering

E. A. WHITE, President FRANK P. HANSON, Secretary-Treasurer

Contributions of interest and value to the agricultural engineering profession are solicited. Communications should be addressed to the Editor—Frank P. Hanson, Station A, Ames, Iowa

A.S.A.E. at Tractor Show

IT IS most appropriate that the American Society of Agricultural Engineers should have an educational booth at the Sixth National Tractor Show at Columbus. Power farming represents a vision, fostered originally by relatively few men, that the use of mechanical motors on the farm would reduce labor requirements, lessen the cost of production, make farming more profitable and benefit the general standing of the farmer and his family. Other men have caught this vision. Today the equipment necessary to make power farming a reality is available. There will be further mechanical improvements, but for the present the limiting factor is the efficient use of the equipment available.

The agricultural world looks to the land grant colleges for facts, facts based on investigations and research. Practically all of these institutions have a department of agricultural engineering the work of which is to apply engineering principles to agricultural practice. These departments should be the advance agents in showing how the use of modern equipment will benefit agriculture. The national tractor show is the rallying point for men who believe that power farming offers possibilities for the introduction of a new era in American agriculture.

It is therefore most appropriate that the agricultural colleges and the U. S. Department of Agriculture should combine interests through the Society which their efforts have created and present an exhibit to show the work which they are doing. It is more than appropriate. It is an unusual opportunity. Agricultural engineering is sadly in need of a larger measure of public support. The way to secure this support is to show the work that is being done, and if this meets with approval the way is opened to show the possibilities of work not yet attempted because of a lack of funds. Our men in scientific work need to become better acquainted with the men in the commercial world, just as the manufacturers of farm equipment need to become more familiar with the work and needs of the agricultural engineering departments in our colleges. We can therefore look upon the placing of an educational exhibit at the coming tractor show as a step towards enlarging the work of the Society—Dr. E. A. White

College Section Organized

AT THE annual meeting, tentative organization of a college section of the Society was perfected. This section was the outcome of a desire to further the interests of agricultural engineering in land grant colleges, experiment stations and extension service and to promote research and better teaching methods and more largely to correlate these activities with those of the United States Department of Agriculture.

The temporary advisory committee hopes to put into effect one of the most far-reaching activities the Society at large has undertaken. The success of the movement is dependent upon the fullest cooperation of all members of the Society who are teachers or investigators either at land grant colleges or experiment stations. All men on agricultural engineering staffs at such institutions who are not already members should be urged to join the Society so that they may be in a position to get the benefit of membership and the cooperative movement.

It is to be hoped that duplication of effort, such as is now frequent, may be reduced; that new problems may be assigned to stations or colleges best suited to handle them; to coordinate work between colleges and experiment stations where located at different points in the same state; to gain for agricultural engineering research problems their proper share of such appropriations by Congress as may be made for research work at the experiment stations; that the resulting unity of effort will bring to agricultural engineering the prestige that it justly merits; that the American Society of Agricultural Engineers will be recognized as second to none among the engineering bodies of the country.

Use your influence wherever it will do the most good. The advisory committee whose names appear elsewhere will appreciate your suggestions—F. W. Ives

Every Member to Get a Member

AT THE annual meeting it was agreed by those present that each should undertake to look up some person qualified for membership in the Society, and secure his membership application. While this action was only a pledge of individual effort binding none but themselves it is to be hoped that the entire membership will feel just as much loyalty and be willing to devote just as much effort toward building up the society as those who publicly committed themselves. Although the membership has grown largely, particularly during the last year, it still is small in comparison with the magnitude of the field it serves and the number of engineers engaged in that field who are eligible to membership and whose membership would be of benefit both to themselves and to the Society. Let it be understood that this is a task not for charter members, active members, influential members, but for every member.

An Apology

AN UNFORTUNATE incident of the Annual Meeting in December was the failure of the report of the educational committee to reach the Secretary in time for reading. F. A. Wirt, chairman, and his committee had prepared a thorough and detailed report, but because it was impossible for him to attend the meeting he forwarded the report in care of the hotel in which the meeting was held. Although mailed several days before the meeting it was not delivered to the Secretary until the evening after the meeting had adjourned.

A Standard Belt Pulley

By **Chris Nyberg***

IN LOOKING over various makes of agricultural machinery, the writer has noticed that the pulleys used are made with arms or spokes of innumerable designs. Some are straight and others are curved, some are tapered with the large end toward the hub, while others have no taper at all, and the number of spokes varies all the way from two up to eight or nine. This same variation also holds true in the design of the rims and hubs of the pulleys. The only reason we can account for this condition to exist is that when patterns for most of the pulleys now in use on agricultural machinery were made, the manufacturers did not employ draftsmen and the designing was left up to the pattern makers, who simply made up a pattern of some kind which would serve the purpose.

While there is a good deal of technical data on the subject, most of it is not in a very convenient form, and nearly all the tables given in the engineering handbooks are taken from the practices of makers of pulleys for transmission machinery. These pulleys are usually made with the same sizes of arms for a great number of different widths of face; this is done in order to have as few patterns as possible. But in order to do that, the spokes will have to be made strong enough for the widest face, which will of course make them a good deal heavier than necessary for the narrower.

The following formulae (refer also to Fig. 1.) were arranged by the writer to be used in the drafting room where he is employed, in order that the design of pulleys there would be uniform although made by different draftsmen:

For single leather belts and rubber or canvas belts up to and including 4 ply

$$A = \sqrt[3]{\frac{DW}{4N}} + 1/8''$$

*Mem. A.S.A.E., chief draftsman, thresher works, Advance-Rumely Company, Laporte, Indiana.

For double leather belts and rubber or canvas belts 5 ply and up

$$A = \sqrt[3]{\frac{3DW}{8N}} + 1/8''$$

N = Number of spokes
D = Diameter of pulley
W = Width of belt
F = Width of face of pulley—W + ½"
A = Width of arm at hub
B = Thickness of arm at hub = .5A
a = Width of arm at rim = .67A
b = Thickness of arm at rim = .5a
T = Thickness of rim at edge = 5/32" for single belt
= 3/16" for double belt

It is not claimed that these formulae contain anything new, as it has been taken from different reliable sources, but was arranged more for the sake of convenience.

The chart is an alternate method of determining the sizes of the arms in pulleys. Both the chart and formula were taken from Halsey's handbook, given as the practice of the Todd and Stanley Mill Furnishing Company. They have been modified slightly so the results obtained correspond more nearly to the practice of two of the largest manufacturers of agricultural machinery.

It is based on a belt pull of 50 pounds per inch width of belt for single belts, and 75 pounds for double belts. The working strength of the material from which the pulleys are made is considered to be 2,000 pounds per square inch. The thickness of rim, length of hub and number of arms are also taken from the practices of these two concerns. The crown of the face and diameter of hub is what one of them has used successfully for years; the other one recommends a slightly higher crown and heavier hub.

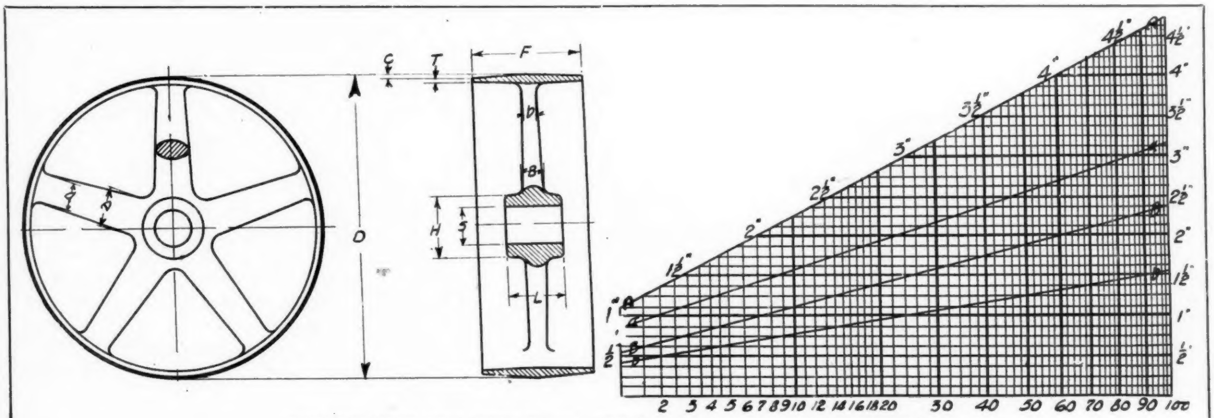


CHART FOR SOLUTION OF PULLEY SPOKE DIMENSIONS

To find the dimensions of the arms of a 12-inch single belt pulley having five arms and for a 5-inch belt substituting these factors in the quantity under the cube root sign for a single belt pulley gives $\frac{12x5}{4x5} = 3$

Locate 3 on the base line, trace upward and read A = 1½ inches, B = ¾ inches, a = 1⅛ inches, and b = 9/16 inches.

A. S. A. E. Activities

A.S.A.E. Officers for 1921

President—E. A. White, technical editor, "Farm Implement News," Chicago, Illinois.
First vice-president—W. G. Kaiser, Portland Cement Association, Chicago, Illinois.
Second vice-president—E. R. Jones, University of Wisconsin, Madison, Wisconsin.
Secretary-treasurer—Frank P. Hanson, Station A, Ames, Iowa.

Executive Council

I. W. Dickerson, agricultural engineering editor, Charles City, Iowa.
F. N. G. Cranich, Hyatt Roller Bearing Co., Chicago Illinois.
Raymond Olney, The Power Farming Press, St. Joseph Michigan.
F. A. Wirt, Emerson-Brantingham Co, Harrisburg, Pennsylvania.
J. B. Davidson, Iowa State College, Ames, Iowa.

Nominating Committee

K. J. T. Ekblaw, engineering editor, The National Farm Power, Chicago, Illinois.
V. V. Detwiler, Clarke Publishing Co., Madison, Wisconsin.
E. S. Fowler, Rockford, Illinois.

College Section Committee

The President has Appointed the Following Members of the Advisory Committee on Coordination of Agricultural Engineering Work of Land Grant Colleges, Experimental Stations and the U. S. Department of Agriculture

F. W. Ives, chairman, Ohio State University.
J. B. Davidson, Iowa State College.
O. W. Sjogren, University of Nebraska.
R. U. Blasingame, Pennsylvania State College.
Wm. Aitkenhead, Purdue University.
E. R. Raney, North Carolina Department of Agriculture.
S. H. McCrory, U.S. Department of Agriculture.

Southern Section of A.S.A.E. to Meet After Tractor Show

THE Southern Section of the American Society of Agricultural Engineers will hold their annual meeting in Lexington, Kentucky, February 14, 15, and 16. The time and place have been chosen with a view to facilitating the attendance of members and others directly following the National Tractor Show at Columbus, Ohio, which closes February 12. Further interest in the meeting is added by the fact that it is being held in connection with a similar meeting of the Association of Southern Agricultural Workers, including joint sessions of the two bodies.

Among the subjects to be discussed are "Standardization of Instruction in Agricultural Engineering in the South" by Daniel Scoates, Texas A. & M. College; "What Should Be Included in a Four-Year Course in Agricultural Engineering" by E. R. Gross, Mississippi A. & M. College; "Opportunity for the Agricultural Engineer Along Commercial Lines" by F. W. Ives, Department of Agricultural Engineering, Ohio State University, and president of the Agricultural Engineering Company, Columbus, Ohio; "The Tractor Situation" by W. G. Welbourne, editor of "Tractor": "Labor-Saving Machinery For Cotton Farmers" by L. E. Rast, Agronomist, Southern Fertilizer Association; "Paint For Farm Buildings" by W. E. Pheris, E. I. DuPont de Nemours & Company, Chicago, Illinois; "Farmstead Arrangement" by J. T. Copeland, Mississippi A. & M. College; "Drainage Investigations in North Carolina" by H. M. Lynde, Senior Drainage Engineer, Raleigh, North Carolina; and "Rural Sanitation In Kentucky" by Dr. J. N. McCormack, State Health Officer, Louisville, Kentucky.

The President's address will be given by Stanley F. Morse, consulting agricultural engineer, New Orleans, Louisiana. It is planned to include during the session excursions to points of special interest in the Blue Grass region. The Southern Section devotes more specialized attention to the distinctive agricultural engineering problems of the South than is possible in the meetings of the Society as a whole. Additional information may be secured from the secretary-treasurer of the Southern Section, Charles E. Seitz, Blacksburg, Virginia.

Engineering News Items

Get Together at Columbus

THE attention of members is called particularly to the Society exhibit which will occupy spaces 712, 713 and 714 in building No. 7 at the tractor show in Columbus, February 7 to 12. It is understood that the exhibit will contain displays from the various departments of agricultural engineering in the various state colleges. The booth will be attractive both as regards appearance and lounging facilities, and all members are urged not only to report to those in charge but to avail themselves freely of the opportunities afforded for rest and congeniality.

Educational Features Mark Tractor Show

IT SHOULD be of more than passing interest to the membership of the American Society of Agricultural Engineers that all but one or two of the men whose names have been announced as headliners for the four-day educational program of the tractor show at Columbus are members of this Society. The agricultural engineering departments of the various state colleges dominate the program and presumably furnish the basis for the claim that it is "a college course in power farming."

The program as thus far announced includes for the first day, February 8, "Soil Conservation" by Frank I. Mann, Gilman, Illinois, famous for his development and practice of a permanent soil improvement program on his home farm, Boisd' Arc Farm; "Adapting the Farm and Farm Business to Power Farming" by Raymond Olney, editor of Power Farming and Power Farming Dealer, St. Joseph, Michigan; "Fac-

tors Which Determine the Type and Size of Tractor to be Purchased" by I. W. Dickerson, agricultural engineering editor of a group of farm papers, Charles City, Iowa; and "The Importance of Lubrication and How to Select Good Oils" by W. F. Parish, technical director lubricating department, Sinclair Refining Company, Chicago, Illinois.

The program for the second day begins with a lecture by J. B. Davidson, Iowa State College, Ames, Iowa, and last year the secretary of the Society, on the "Modern Trend of Tractor Design." "Ignition Troubles and their Remedies" will be discussed by O.W. Sjogren, College of Agriculture, Lincoln, Nebraska. "Tractor Hitches" will be treated by Daniel Scoates, Texas A. & M. College, College Station, Texas. G. W. McCune, Ohio State University, will present "Some Lessons From a Tractor Survey in Ohio."

On the third day there will be "Lessons from the Nebraska Tractor Tests" by C. K. Shedd formerly engineer in charge of tractor tests, College of Agriculture, Lincoln, Nebraska. "The Tractor and Belt Power" will be taken up by Wm. Aitkenhead, College of Agriculture, Purdue University, Lafayette, Indiana. "What is Tractor Service" will be discussed by J. B. Davidson. At this session also R. U. Blasingame, Pennsylvania State College, will discuss the question "Should A Tractor or Tractor Tools be Purchased by Community Groups."

The fourth and last day of the educational program, February 11, will be opened by H. H. Musselman, professor of farm mechanics, Michigan Agricultural College, East Lansing, Michigan, with a discussion of "Correct Tools for the Tractor." F. W. Duffee, College of Agriculture, University of Wisconsin, will take up "Laying off the Field for Plowing." He will be followed by R. U. Blasingame with a talk on "Winter Care of the Tractor," after which F. W. Ives, professor of agricultural engineering, Ohio State University, will discuss "Housing the Tractor and Tractor Tools." On this day four farmers will be asked to tell their experiences with a view to assisting with their experience the other farmers present and in fact all who are anxious to know the farmer's viewpoint and meet his requirements. With the exception of these farmers every person appearing on the last three days of the program are members of our Society.

It is planned to have each day's session close with a round table discussion at which it may be expected that many important points will be brought to light.

Automotive Engineers to Meet in Chicago And Columbus

ON FEBRUARY 2, 1921, at tthe Hotel Morrison in Chicago, the Society of Automotive Engineers will have morning and afternoon sessions, one devoted chiefly to the trend in truck design, including a paper on an interesting development in steam truck design. The other session is to deal with the operation of automotive vehicles from the viewpoint of the service man and owner, in which it is expected that the engineers responsible for the design of these vehicles will hear some valuable constructive criticisms. In the evening will occur the annual Chicago dinner, which is of the same importance in the Midwest that the New York dinner is in the East.

The Columbus meeting will be held February 10 at the Hotel Deshler. The morning and afternoon sessions will be devoted to automotive engineering as it occurs in farm power. Among the subjects to be discussed are the trend of tractor design, plowing and belt speeds, and the lessons learned from the Nebraska tests. The stationary engine will receive consideration also in relation to its use for lighting, pumping and all-round farm utility. The evening will be devoted to a farm power dinner on which occasion the Society of Automotive Engineers will hold a get-together for the tractor, lighting plant, and farm engine interests of the industry.

Personal Items

F. W. Ives, Ohio State University, Columbus, Ohio, was recently elected to the advisory council of the "Architectural Forum." This council is made up of ten or twelve architects who are very carefully selected because of their exceptional qualifications and standing in some particular field. Prof. Ives will be the agricultural engineer on the council.

James B. Green, formerly at the Ohio State University, is now mechanical engineer for the Reliable Tractor and Engine Company, Portsmouth, Ohio.

E. B. McCormick, mechanical engineer, Bureau of Public Roads, Washington, D. C., was appointed by President E. A. White to represent the American Society of Agricultural Engineers at the National Conference on Highway Traffic Regulations which was held at the Hotel Washington, Washington, D. C., Monday, January 10.

B. E. Gaylord, formerly with the Gordon Van Tine Company, Davenport, Iowa, is now farm buildings engineer for the Weyerhaeuser Forest Products, St. Paul, Minn.

New Members of the Society

Americo de Miranda Ludoff, special student in agricultural engineering, Ames, Iowa.

Joao V. de Oliveria, special student in agricultural engineering,Ames,Iowa.

Djalma Hees, special student in agricultural engineering, Ames, Iowa,

Robert H. Coolidge, supervisor of production, U. S. Ball Bearing Manufacturing Co., Chicago, Ill.

Ernest Wayne Smith, sales correspondent, John Lauson Manufacturing Company, New Holstein, Wis.

George A. Fain, professor of agricultural engineering Georgia State College of Agriculture, Athens, Ga.

G. M. Foulkrod, instructor in farm mechanics, Pennsylvania State College.

S. C. Hurley, salesman, Diamond Chain Manufacturing Company, Indianapolis, Indiana.

John Thomas McAlister, instructor in agricultural engineering, Mississippi A. & M. College, Mississippi.

David S. Weaver, instructor in agricultural engineering, Mississippi A. & M. College, Miss.

David P. Davis, vice-president J. I. Case Threshing Machine Co., St. Louis, Missouri.

Norman R. Krause, mechanical engineer, J. I. Case T. M. Company, Racine, Wis.

Howard Ross Tolley, agricultural engineer, Bureau of Public Roads, U. S. Dept. of Agriculture, Washington, D. C.

Geo. H. Dechant, advertising manager, J. I. Case T. M. Company, Racine, Wis.

Samuel Eugene Craig, chief draftsman, gas tractor department, J. I. Case T. M.Company,Racine,Wis.

Geo. G. Dana, chief draftsman, J. I. Case T. M. Co., Racine, Wis.

Chas. W. Robinson, superintendent of experiments, International Harvester Company, Auburn, New York.

Wm. C. Shinn, President, Shinn Mfg. Company Chicago, Illinois.

J. A. Leprince, senior sanitary engineer, U. S. Public Health Service, Memphis, Tenn.

Robert Ethan Allen, in charge agricultural engineering department, West Virginia University, Morgantown, W. Va.

J. F. Forrest, proprietor of the Electric Farm, Poynette, Wisconsin.

Ira L. Johnson, experimental engineer, Minneapolis Steel and Machinery Company, Minneapolis, Minnesota.

James Edward Holbrook, factory sales representative, Yuba Mfg. Co., Marysville, Calif.

Jno. D. Parsons, assistant professor agricultural engineering, University of Nebraska, Lincoln, Nebraska.

Edwin Courtney Billings, service dept. J. I. Case T. M. Company, Racine, Wisconsin.

Arch R. Crawford, advertising manager "The Farmer," St. Paul, Minn.

Roudolph H. Driftmier, instructor farm machinery, Kansas State Agricultural College, Manhattan, Kansas.

Ellis S. Echlin, service engineer, J. I. Case T. M. Company, Racine, Wis.

James Ira Winchell, manager tractor department, Horst & Strieter Company, Rock Island, Illinois.

Applications for Membership

The following is a list of applications for membership received since the publication of the December issue of AGRICULTURAL ENGINEERING. Members of the Society are urged to send promptly pertinent information relative to the applicants for consideration of the Council prior to their election.

Walter G. Ward, extension architect Division of Extension, Kansas State Agricultural College, Manhattan, Kansas.

Harley M. Ward, Engineer, Hollow Tile Ass'n, Chicago, Illinois.

J. H. Needler, Sales Engineer, Link Belt Company, Chicago, Ill.

Harry B. Cole, Assistant Experimental Engineer, Moline Plow Company, Moline, Ill.

Fred L. Warner, Chain Sales Engineer, Link Belt Company, Ewart Works, Indianapolis, Indiana.

R. B. Wheeler, Sales Dept. Roderick Lean Mfg. Company, Mansfield, Ohio.

Carlyle A. Atherton, Engineer National Lamp Works of General Electric Company, Nela Park, Cleveland, Ohio.

Quincy Claude Ayres, Ass't Prof. Agricultural Engineering, Iowa State College, Ames, Iowa.

Ray Wilford Carpenter, Professor of Agricultural Engineering, University of Maryland, College Park, Md.

Lewis Allen Jones, Senior Drainage Engineer, U. S. Dept of Agriculture, Takoma Park, D. C.

Walter A. Kirkpatrick, Managing Editor Chilton Tractor Index; Associate editor, Chilton Tractor Journal, Philadelphia, Pa.

Arthur L. Kline, salesman and agricultural service man, Hercules Powder Company, Wausau, Wisconsin.

George S. Knapp, State Irrigation Commissioner State of Kansas, Topeka, Kansas.

George H. McCray, Service Engineering Department, J. I. Case T. M. Co., Racine, Wis.

Elmer Reynolds Meacham, Ass't Prof. of Farm Machinery and Agronomy, Clemson Agricultural College, Clemson College, South Carolina.

Gustave Howard Radebaugh, Department Mechanical Engineering, Assistant Professor, University of Illinois, Urbana, Illinois.

Walter J. Taylor, Sales Engineer, John Lauson Manufacturing Co., New Holstein, Wis.